

# UNION TOOL

## Tungsten Carbide End Mills UNIMAX Series · V Series Vol.21



1 Flute

2 Flutes

3 Flutes

4 Flutes

5 Flutes

6 Flutes

10 Flutes

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Square  
Long Neck  
Square

Radius  
Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Ball  
Long Neck  
Ball

Taper Neck  
Ball

Taper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



UNION TOOL CO.

# UNIMAX End Mills Tool Finder

- Our catalogue PDF data and DXF files can be downloaded.
- Products that meet your needs can be searched by tool types, sizes, series names and work materials.

▼ View from here ▼

For smart devices



For computers

UNIMAX end mill tool finder

Search





# TOOL T N N N

- 1 Flute .....
- 2 Flutes .....
- 3 Flutes .....
- 4 Flutes .....
- 5 Flutes .....
- 6 Flutes .....
- 10 Flutes .....

●  $\phi$ 3mm Shank V Series / 32-58 .....

● For Cemented Carbide UDC·PCD / 60-116 .....



● CBN Series / 118-151 .....

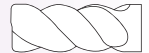
● Square / 152-241 .....



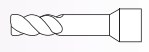
● Long Neck Square / 242-301 .....



● Radius / 302-323 .....



● Long Neck Radius / 324-411 .....



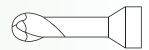
● Taper Neck Radius / 412-421 .....



● Ball / Long Shank Ball / 422-459 .....



● Long Neck Ball / 460-535 .....



● Taper Neck Ball / 536-563 .....



● Taper / 564-571 .....



● Barrel / 572-577 .....



● Spiral V Cutter / 578-579 .....



● Drill / 580-601 .....



● Technical Data / 602-608 .....

1 Flute

2 Flutes

3 Flutes

4 Flutes

5 Flutes

6 Flutes

10 Flutes

$\phi$ 3mm Shank  
V Series

UDC·PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

# Index

## Alphabetical Order

| Model Number | Page | Characteristic  |
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| <b>C</b>     |      |   |
| CAS          | 192  | 2 Flute Square  |
| CBN-LBF      | 126  | 2 Flute CBN Long Neck Ball                              |
| CBN-LBSF     | 122  | 2 Flute CBN Long Neck Ball                              |
| CBN-LRF2000  | 136  | 2 Flute CBN Long Neck Radius                            |
| CBN-LRF4000  | 146  | 4 Flute CBN Long Neck Radius                            |
| CBN-PLB      | 120  | 2 Flute CBN Long Neck Ball                              |
| CBN-RSF      | 132  | 1 Flute CBN Long Neck Radius                            |
| CESUS        | 228  | 4 Flute Square  |
| CFB          | 442  | 3 Flute Ball  |
| CFLB         | 530  | 3 Flute Long Neck Ball                                  |
| GGB2000      | 440  | 2 Flute Ball  |
| GGB4000      | 458  | 4 Flute Ball  |
| CGE          | 236  | 4 Flute Square  |
| CNRS         | 306  | 4 Flute Radius  |
| COVB         | 572  | 4 Flute Oval Barrel Form                                |
| CPR          | 270  | 2 Flute Long Neck Square                                |
| CPRB         | 526  | 2 Flute Long Neck Ball                                  |
| CPRL         | 274  | 2 Flute Long Neck Square (Long Shank)                   |
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| CSTB         | 574  | 4 Flute Standard Taper Barrel Form                      |
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| Model Number | Page | Characteristic                                |
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| CXES         | 216  | 4 Flute Square                                |
| CXLRS        | 400  | 5 Flute Long Neck Radius                      |
| CXRS         | 316  | 5 Flute Radius                                |
| CXS          | 294  | 4 Flute Long Neck Square                      |
| CZS          | 202  | 4 Flute Square                                |
| C-CER        | 256  | 2 Flute Long Neck Square for Deep Rib Milling |
| C-CES2000    | 166  | 2 Flute Square                                |
| C-CES2000S   | 180  | 2 Flute Square (Sharp Corner)                 |
| C-CES4000    | 194  | 4 Flute Square                                |
| C-CES4000S   | 200  | 4 Flute Square (Sharp Corner)                 |
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| C-UMD        | 588  | 2 Flute UNIMAX Drill                          |
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| DCB          | 438  | 2 Flute Ball                                  |
| DCES2000     | 188  | 2 Flute Square                                |
| DCES4000     | 234  | 4 Flute Square                                |
| DCLB         | 512  | 2 Flute Long Neck Ball                        |
| DCLRS        | 396  | 4 Flute Long Neck Radius                      |
| DCLS         | 266  | 2 Flute Long Neck Square                      |
| DCTNB        | 556  | 2 Flute Taper Neck Ball                       |
| DLC-AZS      | 282  | 3 Flute Long Neck Square                      |
| DLC-CFB      | 448  | 3 Flute Ball                                  |
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| HLRS2000E    | 324  | 2 Flute Long Neck Radius (High Radius Accuracy) |
| HLS2000      | 242  | 2 Flute Long Neck Square                        |
| HLS4000      | 288  | 4 Flute Long Neck Square                        |
| HMERS        | 320  | 4 Flute / 6 Flute Radius                        |
| HMS          | 238  | 3-6 Flute Square                                |
| HRRS         | 382  | 4 Flute Long Neck Radius                        |
| HRRS-S       | 388  | 4 Flute Long Neck Radius (Short Shank)          |
| HSB          | 424  | 2 Flute Ball (R0.05: Single Flute)              |
| HSB-S        | 428  | 2 Flute Ball (Short Shank)                      |
| HSLB         | 476  | 2 Flute Long Neck Ball                          |
| HSLB-S       | 492  | 2 Flute Long Neck Ball (Short Shank)            |
| HTNB         | 536  | 2 Flute Taper Neck Ball                         |
| HTNRS        | 412  | 4 Flute Taper Neck Radius                       |
| HWLB         | 470  | 2 Flute Long Neck Ball                          |
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| Model Number | Page | Characteristic                                  |
|--------------|------|---|
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| PMD PLT      | 599  | P Series Non-coat Drill for Pilot Hole Drilling |
| PSM          | 599  | P Series Gun Barrel Drill                       |
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| UDCBF        | 70   | 2 Flute Ball                                    |
| UDCBH        | 68   | 2 Flute Ball                                    |
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| UPDLB        | 88   | 1 Flute Long Neck Ball                          |
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| UTDF         | 580  | 2 Flute UNIMAX Flat Drill                       |
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| VDLCLB       | 48   | 2 Flute Long Neck Ball (Short Shank)            |
| VHGLB        | 34   | 2 Flute Long Neck Ball (Short Shank)            |
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| VHLS         | 52   | 2 Flute Long Neck Square (Short Shank)          |
| VHSLB        | 37   | 2 Flute Long Neck Ball (Short Shank)            |

# How to find your tool

Cover page



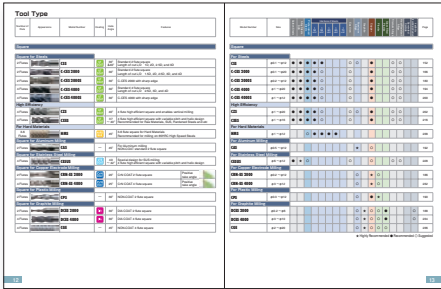
Search by number of flutes or shape from index



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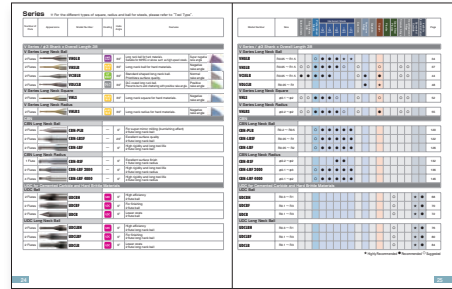
Search by end geometry

P.12~23



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Search by series name



To the main description

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5 Flutes UTCOAT

Size: #1.2~#12

CSS

Material Applications: **H** Highly Recommended, **R** Recommended, **S** Suggested

Unique Cross Section design

Conventional CSS

Face shape

Cross section

Total 112 models

| Model Number | Outside Diameter #2 | Length of Cut | Shank Length | Shank Dia | Shank Length L | Shank Diameter #2 | Suggested Feed Rate (mm) |
|--------------|---------------------|---------------|--------------|-----------|----------------|-------------------|--------------------------|
| CSS 200-0815 | 0.1                 | 1.0           | 45           | 0.1       | 45             | 0.1               | 0.05                     |
| CSS 200-0815 | 0.15                | 1.0           | 45           | 0.15      | 45             | 0.15              | 0.05                     |
| CSS 200-0815 | 0.2                 | 1.0           | 45           | 0.2       | 45             | 0.2               | 0.05                     |
| CSS 200-0815 | 0.3                 | 1.0           | 45           | 0.3       | 45             | 0.3               | 0.05                     |
| CSS 200-0815 | 0.4                 | 1.0           | 45           | 0.4       | 45             | 0.4               | 0.05                     |
| CSS 200-0815 | 0.5                 | 1.0           | 45           | 0.5       | 45             | 0.5               | 0.05                     |
| CSS 200-0815 | 0.6                 | 1.0           | 45           | 0.6       | 45             | 0.6               | 0.05                     |
| CSS 200-0815 | 0.8                 | 1.0           | 45           | 0.8       | 45             | 0.8               | 0.05                     |
| CSS 200-0815 | 1.0                 | 1.0           | 45           | 1.0       | 45             | 1.0               | 0.05                     |
| CSS 200-0815 | 1.2                 | 1.0           | 45           | 1.2       | 45             | 1.2               | 0.05                     |
| CSS 200-0815 | 1.5                 | 1.0           | 45           | 1.5       | 45             | 1.5               | 0.05                     |
| CSS 200-0815 | 2.0                 | 1.0           | 45           | 2.0       | 45             | 2.0               | 0.05                     |
| CSS 200-0815 | 2.5                 | 1.0           | 45           | 2.5       | 45             | 2.5               | 0.05                     |
| CSS 200-0815 | 3.0                 | 1.0           | 45           | 3.0       | 45             | 3.0               | 0.05                     |
| CSS 200-0815 | 4.0                 | 1.0           | 45           | 4.0       | 45             | 4.0               | 0.05                     |
| CSS 200-0815 | 5.0                 | 1.0           | 45           | 5.0       | 45             | 5.0               | 0.05                     |
| CSS 200-0815 | 6.0                 | 1.0           | 45           | 6.0       | 45             | 6.0               | 0.05                     |
| CSS 200-0815 | 8.0                 | 1.0           | 45           | 8.0       | 45             | 8.0               | 0.05                     |
| CSS 200-0815 | 10.0                | 1.0           | 45           | 10.0      | 45             | 10.0              | 0.05                     |
| CSS 200-0815 | 12.0                | 1.0           | 45           | 12.0      | 45             | 12.0              | 0.05                     |

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# Icon Guide Lines

unit : mm

## Tool Material



Super Micro Grain



CBN



Micro Grain



Binderless PCD

## Coating



HMGCOAT



UTSCOAT



HMWCOAT



CrN COAT



HARDMAX



UDC



UTCOAT



DIA



UT MICRO COAT



DLC

## Geometry



Corner Radius Design



Back Taper Geometry



Sharp Corner Design



Variable Pitch



Flatland Design



Variable Helix



X Thinning Design

## Shank Diameter Tolerance



Tolerance of Shank Diameter : 0/-0.003



Tolerance of Shank Diameter : 0/-0.004



Tolerance of Shank Diameter : 0/-0.005

## Ball Radius Tolerance



Ball Radius Tolerance : ±0.002



Ball Radius Tolerance : ±0.005



Ball Radius Tolerance : ±0.003



Ball Radius Tolerance : ±0.007



Ball Radius Tolerance : ±0.004



Ball Radius Tolerance : ±0.01

## Form Tolerance



Form Tolerance

## Corner Radius Tolerance



Corner Radius Tolerance : ±0.002



Corner Radius Tolerance : ±0.01



Corner Radius Tolerance : ±0.003



Corner Radius Tolerance : ±0.015



Corner Radius Tolerance : ±0.005



Corner Radius Tolerance : ±0.02

## Half Included Angle Tolerance



Half Included Angle Tolerance : ±5'

## Helix Angle



Helix Angle 0°



Helix Angle 42°~45°



Helix Angle 20°



Helix Angle 45°



Helix Angle 24°



Helix Angle 0°



Helix Angle 25°



Helix Angle 20°



Helix Angle 30°



Helix Angle 30°



Helix Angle 37°~40°



Helix Angle 35°



Helix Angle 40°



Helix Angle 40°












Helix Angle 40°~42°

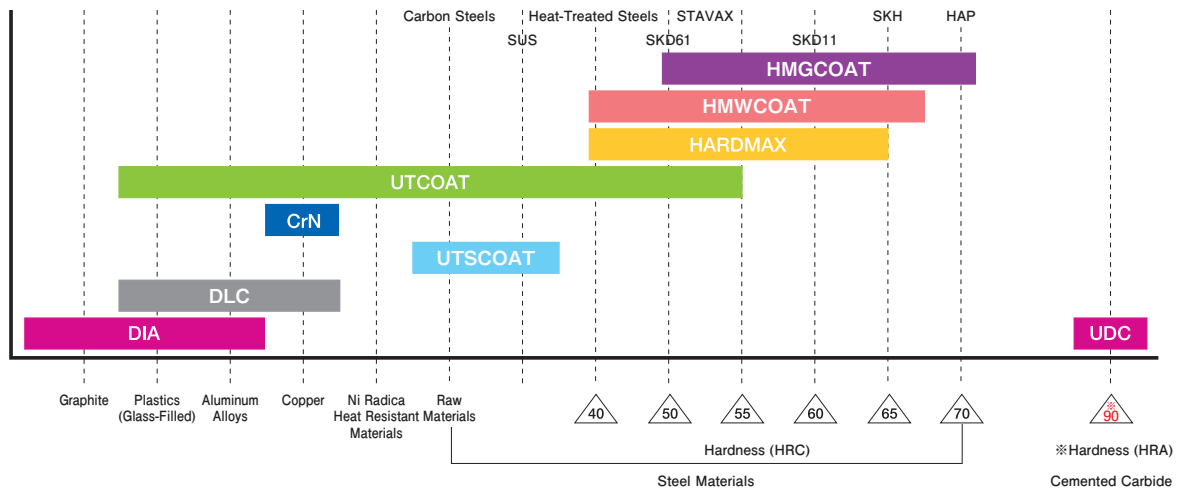


# Features of Coating

★Highly Recommended ●Recommended ○Suggested △Satisfactory

| Coating Series |   | Hardness (HV) | Heat Resistance | Toughness | Lubricant Efficiency | Recommended Use                               |
|----------------|---|---------------|-----------------|-----------|----------------------|---|
| Ceramics based | HMGCOAT  | 3700~4200     | ★               | ○         | ●                    | For Steels                                    |
|                | HMWCOAT  | 3700~4000     | ★               | ●         | ●                    |   |
|                | HARDMAX  | 3500~4000     | ★               | ○         | ●                    |   |
|                | UTCOAT   | 3000~3500     | ●               | ●         | ★                    | For Copper / Raw Materials up to 55HRC        |
|                | UTSCOAT  | 3000~3500     | ●               | ●         | ★                    | For Stainless Steels                          |
|                | CrN      | 2000~2200     | ○               | ●         | ★                    | For Copper                                    |
| DLC            | DLC      | 4000~6000     | △               | △         | ★                    | For Copper / Aluminum / Plastics              |
| Diamond        | DIA      | around 9000   | △               | △         | ●                    | For Graphite                                  |
|                | UDC      | around 9000   | △               | ○         | ●                    | For Cemented Carbide / Hard Brittle Materials |

## How to find best coating for your material applications





## Advisory for Safe Use of End Mills

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Correct application and operation is strongly advised to avoid clogging, abrasion, etc, that could cause serious accidents or injuries.

Ignition or sparks generated during milling could lead to fire or extreme damage to the work piece.

End Mills are made with very sharp cutting edges and must be handled with extra care.

- Never touch the cutting edge with your bare hands, as this could cause serious injury. Special caution is required when opening the package.
- Dropping the tool could cause breakage or flying debris, leading to serious injury.
- During milling, unexpected impact or shock on the tool could cause breakage or flying debris. Ensure to use protective items such as safety glasses and a face guard.
- For best results, fine parameter adjustment may be required, depending on the materials; milling shape and strategy; machine rigidity and spindle capability.
- Use a machine that has high rigidity and generates a low level of vibration. Recommend setting the runout control value at  $5\mu\text{m}$  or below for the small diameter tools  $\phi 1$  or below.
- Do not use flammable cutting oils.

### Advisory for Regrinding End Mills

- Never regrind the tool without wearing safety glasses and a face guard.

## Value Series

Φ3 Shank × Overall length 38mm

### VHGLB

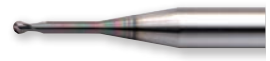
For Hard Materials  
2 Flutes Long Neck Ball



34

### VDLCLB

DLCCOAT for  
Copper and Aluminum  
2 Flutes Long Neck Ball



48

### VHSLB

For Hard Materials  
2 Flutes Long Neck Ball



37

### VHLS

HARDMAX  
2 Flutes Long Neck Square



52

### VCSELB

For Raw Materials and up to 55HRC  
2 Flutes Long Neck Ball



44

### VHLRS

HARDMAX  
2 Flutes Long Neck Radius



55

## For Cemented Carbide / Hard Brittle Materials

### UDC Series

### UDCLBH

For higher efficiency  
2 Flutes High-speed Long Neck Ball



76

### UDCRRS

6 Flutes / 10 Flutes  
High Efficiency Long Neck Radius



104

## CBN Series

### CBN-PLB

For Super Mirror Milling  
2 Flutes Long Neck Ball



120

### CBN-LRF4000

Long Tool Life  
4 Flutes Long Neck Radius



146

## HMWCOAT Series

### HWLB

For Hard Materials  
2 Flutes Long Neck Ball



470

# NEW PRODUCTS

## For Hard Materials HMGCOAT Series

### HGRRS

High Efficiency for  
Hard Materials  
5 Flutes / 6 Flutes Long Neck Radius



408

### HGLRS

For Hard Materials  
4 Flutes Long Neck Radius



344

## For Highly Efficient Finishing Barrel End Mills

### COVB

4 Flutes Oval Barrel Form



572

### CSTB

4 Flutes  
Standard Taper Barrel Form



574

### CWTB

4 Flutes  
Wide Taper Barrel Form



576

# ADDITIONAL MODELS

## For Cemented Carbide / Hard Brittle Materials UDC Series

### UDCBH

For higher efficiency  
2 Flutes High-speed Ball



68

### UDCBF

For better surface finish  
2 Flutes High-grade Ball



70

### UDCLRSF

For better surface finish  
2 Flutes High-grade Long Neck Radius



90

## CBN Series

### CBN-LBF

Long Tool Life  
2 Flutes Long Neck Ball



126

### CBN-LRF2000

Long Tool Life  
2 Flutes Long Neck Radius



136

## For Hard Materials HARDMAX Series

### HHR









4 Flutes / 6 Flutes  
High-rigidity Long Neck Radius







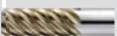





404

# Tool Chart

## Square / Long Neck Square for Steel

|                 | Copper, Raw Materials                                | ~40HRC   | ~50HRC                           | ~60HRC  | ~70HRC |
|-----------------|--|--|----------------------------------|---|--------|
| High efficiency |  |  | For Hard Materials<br>3~6 Flutes | <b>HMS</b>  | 238    |
|                 | 4 Flutes Drillable Square                            | <b>CZS</b>              | 202                              |   |        |
|                 | 4 Flutes Variable pitch and helix                    | <b>CXES/CXS</b>         | 216<br>294                       |   |        |
| Multi-purpose   | 4 Flutes for SUS<br>Variable pitch and helix         | <b>CESUS</b>            | 228                              |   |        |
|                 | 2 Flutes Multi-purpose                               | <b>CSS</b>              | 152                              |   |        |
| Finishing       | 2 Flutes / 4 Flutes Multi-purpose                    | <b>C-CES 2000/4000</b>  | 166<br>194                       |   |        |
|                 | 2 Flutes Long Neck Square<br>· Tip design : Negative | <b>HLS 2000/4000</b>  | 242<br>288                       |   |        |
|                 | 2 Flutes Long Neck Square<br>· Tip design : Positive | <b>C-CER</b>            | 256                              |   |        |








## Radius / Long Neck Radius for Steel

|                 | Copper, Raw Materials                             | ~40HRC  | ~50HRC  | ~60HRC  | ~70HRC   |  |     |
|-----------------|---|---|---|---|--|--|-----|
| High efficiency |   |   | 5 Flutes / 6 Flutes<br>For bottom surface milling | <b>HGRRS</b>  | 408  |  |     |
|                 | 5 Flutes Variable pitch and helix                 | <b>CXRS/CXLRS</b>      | 316<br>400  |   |  |  |     |
|                 | 4 Flutes Variable pitch                           |   | 4 Flutes Variable pitch and helix                 | <b>HRRS</b>   | 382  |  |     |
|                 | 4 Flutes Variable pitch                           | <b>CRRS</b>            | 390   | 4 Flutes / 6 Flutes<br>For high efficiency side milling   | <b>HMERS</b>  | 320  |     |
| Multi-purpose   | 4 Flutes For difficult to cut materials           | <b>CNRS</b>            | 306   | 4 Flutes / 6 Flutes<br>High-rigidity  | <b>HHRS</b>     | 404  |     |
|                 | 2 Flutes Multi-purpose                            | <b>C-CRS</b>           | 302   |   | 4 Flutes<br>For Hard Materials and high-precision milling  | <b>HGLRS</b>  | 344 |
|                 | 2 Flutes / 4 Flutes<br>For high-precision milling | <b>HLRS 2000/4000</b>  | 324<br>358  |   |  |  |     |



# Tool Chart

## Ball / Long Neck Ball for Steel

|            | Copper, Raw Materials | ~40HRC  | ~50HRC  | ~60HRC   | ~70HRC   |
|------------|-----------------------|---|---|--|--|
| Negative   |                       |   | 2 Flutes For Hard Materials · Tip design : Negative | <b>HGB/HGLB</b>  |  <br>422<br>460 |
|            |                       |   | 2 Flutes For Hard Materials · Tip design : Negative | <b>HWLB</b>  |  470   |
| Tip design |                       | 2 Flutes For Hard Materials · Tip design : Negative                       | <b>HSB/HSLB</b>                                     |  <br>424<br>476 |  |
| Positive   |                       | 2 Flutes Multi-purpose / For better surface finish · Tip design : Neutral | <b>CSEB/CSELB</b>                                   |  <br>432<br>496  |  |

|                     | Copper, Raw Materials | ~40HRC                           | ~50HRC                           | ~60HRC  | ~70HRC  |
|---------------------|-----------------------|----------------------------------|----------------------------------|---|---|
| 3 Flutes / 4 Flutes |                       | 3 Flutes · Tip design : Positive | <b>CFB/CFLB</b>                  |  <br>442<br>530 |   |
|                     |                       |                                  | 4 Flutes · Tip design : Negative | <b>HFB</b>  |  452 |

| For Graphite |                                    |     |
|--------------|------------------------------------|-----|
| Square       | DCES2000<br>(All Flute / 2 Flutes) | 188 |
|              | DCES4000<br>(All Flute / 4 Flutes) | 234 |
|              | DCLS<br>(Long Neck / 2 Flutes)     | 266 |
| Radius       | DCLRS<br>(Long Neck / 4 Flutes)    | 396 |
| Ball         | DCB<br>(All Flute / 2 Flutes)      | 438 |
|              | DCLB<br>(Long Neck / 2 Flutes)     | 512 |
|              | DCTNB<br>(Taper Neck / 2 Flutes)   | 556 |

| For Copper |                                      |     |
|------------|--------------------------------------|-----|
| Square     | CRN-ES2000<br>(All Flute / 2 Flutes) | 186 |
|            | CRN-ES4000<br>(All Flute / 4 Flutes) | 232 |
| Ball       | DLCLB<br>(Long Neck / 2 Flutes)      | 516 |
|            | VDLCLB<br>(Long Neck / 2 Flutes)     | 48  |

| For Heat Resistant Alloys |                                |     |
|---------------------------|--------------------------------|-----|
| Radius                    | CNRS<br>(All Flute / 4 Flutes) | 306 |
|                           | CRRS<br>(Long Neck / 4 Flutes) | 390 |
| Ball                      | CFB<br>(All Flute / 3 Flutes)  | 442 |
|                           | CFLB<br>(Long Neck / 3 Flutes) | 530 |

| For Plastics |                                |     |
|--------------|--------------------------------|-----|
| Square       | CPS<br>(All Flute / 2 Flutes)  | 190 |
|              | CPR<br>(Long Neck / 2 Flutes)  | 270 |
|              | CPRL<br>(Long Neck / 2 Flutes) | 274 |
| Ball         | CPRB<br>(Long Neck / 2 Flutes) | 526 |






| For Aluminum Alloys    |                                       |                                   |
|------------------------|---------------------------------------|-----------------------------------|
| Square<br>(Finishing)  | CAS<br>(All Flute / 2 Flutes)         | 192                               |
| Square<br>(Efficiency) | AZS/DLC-AZS<br>(Long Neck / 3 Flutes) | 278<br>282                        |
|                        | Ball                                  | DLC-CFB<br>(All Flute / 3 Flutes) |

# Tool Type



| Number of Flute | Appearance | Model Number | Coating | Helix Angle | Features |
|-----------------|------------|--------------|---------|-------------|----------|
|-----------------|------------|--------------|---------|-------------|----------|

## Square

### Square for Steels

|          |   |                    |         |           |   |
|----------|---|--------------------|---------|-----------|---|
| 2 Flutes |  | <b>CSS</b>         | UT COAT | 30° & 40° | Standard 2 flute square<br>Length of cut L/D 1D, 2D, 2.5D, and 3D       |
| 2 Flutes |  | <b>C-CES 2000</b>  | UT COAT | 30°       | Standard 2 flute square<br>Length of cut L/D 1.5D, 2D, 2.5D, 3D, and 4D |
| 2 Flutes |  | <b>C-CES 2000S</b> | UT COAT | 30°       | C-CES 2000 with sharp edge  |
| 4 Flutes |  | <b>C-CES 4000</b>  | UT COAT | 30°       | Standard 4 flute square<br>Length of cut L/D 2.5D, 3D, and 4D           |
| 4 Flutes |  | <b>C-CES 4000S</b> | UT COAT | 30°       | C-CES 4000 with sharp edge  |

### High Efficiency

|          |   |             |         |           |   |
|----------|---|-------------|---------|-----------|---|
| 4 Flutes |  | <b>CZS</b>  | UT COAT | 40°       | 4 flute highly efficient square and enables vertical milling  |
| 4 Flutes |  | <b>CXES</b> | UT COAT | 37° ~ 40° | 4 flute highly efficient square with variable pitch and helix design<br>Recommended for Raw Materials, SUS, Hardened Steels and etc |


### For Hard Materials

|            |   |            |          |     |   |
|------------|---|------------|----------|-----|---|
| 3-6 Flutes |  | <b>HMS</b> | HARD MAX | 45° | 3-6 flute square for Hard Materials<br>Recommended for milling on 65HRC High Speed Steels |
|------------|---|------------|----------|-----|---|




### Square for Aluminum Milling

|          |   |            |   |     |  |
|----------|---|------------|---|-----|--|
| 2 Flutes |  | <b>CAS</b> | — | 45° | For Aluminum milling<br>NON-COAT standard 2 flute square |
|----------|---|------------|---|-----|--|

### Square for Stainless Steel Milling

|          |  |              |          |           |  |
|----------|--|--------------|----------|-----------|--|
| 4 Flutes |  | <b>CESUS</b> | UTS COAT | 40° ~ 42° | Special design for SUS milling<br>4 flute highly efficient square with variable pitch and helix design |
|----------|--|--------------|----------|-----------|--|

### Square for Copper Electrode Milling

|          |   |                    |          |     |                         |   |
|----------|---|--------------------|----------|-----|-------------------------|---|
| 2 Flutes |  | <b>CRN-ES 2000</b> | CrN COAT | 20° | CrN COAT 2 flute square | Positive rake angle  |
| 4 Flutes |  | <b>CRN-ES 4000</b> | CrN COAT | 25° | CrN COAT 4 flute square | Positive rake angle  |

### Square for Plastic Milling

|          |   |            |   |     |                         |
|----------|---|------------|---|-----|-------------------------|
| 2 Flutes |  | <b>CPS</b> | — | 30° | NON-COAT 2 flute square |
|----------|---|------------|---|-----|-------------------------|

### Square for Graphite Milling

|          |   |                  |     |     |                         |
|----------|---|------------------|-----|-----|-------------------------|
| 2 Flutes |  | <b>DCES 2000</b> | DIA | 30° | DIA COAT 2 flute square |
| 4 Flutes |  | <b>DCES 4000</b> | DIA | 30° | DIA COAT 4 flute square |
| 4 Flutes |  | <b>CGE</b>       | —   | 45° | NON-COAT 4 flute square |

| Model Number | Size | Carbon Steels | Alloy Steels<br>SUS | Prehardened<br>Steels | Hardened Steels |           |           |           |           | Cast Iron | Aluminum<br>Alloys | Graphite | Copper | Plastics | Glass Filled<br>Plastics | Titanium Alloys | Heat Resistant<br>Alloys | Cemented<br>Carbide | Hard Brake<br>(Non-Metallic) Materials | Page |
|--------------|------|---------------|---------------------|-----------------------|-----------------|-----------|-----------|-----------|-----------|-----------|--------------------|----------|--------|----------|--------------------------|-----------------|--------------------------|---------------------|--|------|
|              |      |               |                     |                       | 50<br>HRC       | 55<br>HRC | 60<br>HRC | 65<br>HRC | 70<br>HRC |           |                    |          |        |          |                          |                 |                          |                     |  |      |

## Square

### For Steels

|                    |            |   |   |   |   |   |  |  |  |  |   |   |  |   |  |  |   |   |  |  |     |
|--------------------|------------|---|---|---|---|---|--|--|--|--|---|---|--|---|--|--|---|---|--|--|-----|
| <b>CSS</b>         | φ0.1 ~ φ12 | ● | ● | ● | ● | ● |  |  |  |  | ○ | ○ |  | ● |  |  | ○ | ○ |  |  | 152 |
| <b>C-CES 2000</b>  | φ0.1 ~ φ20 | ● | ● | ● | ● | ○ |  |  |  |  | ○ |   |  | ● |  |  | ○ | ○ |  |  | 166 |
| <b>C-CES 2000S</b> | φ0.2 ~ φ12 | ● | ● | ● | ● | ○ |  |  |  |  | ○ |   |  | ● |  |  | ○ | ○ |  |  | 180 |
| <b>C-CES 4000</b>  | φ1 ~ φ20   | ● | ● | ● | ● | ○ |  |  |  |  | ○ |   |  | ● |  |  | ○ | ○ |  |  | 194 |
| <b>C-CES 4000S</b> | φ1 ~ φ12   | ● | ● | ● | ● | ○ |  |  |  |  | ○ |   |  | ● |  |  | ○ | ○ |  |  | 200 |

### High Efficiency

|             |          |   |   |   |   |   |  |  |  |  |   |   |  |   |  |  |   |   |  |  |     |
|-------------|----------|---|---|---|---|---|--|--|--|--|---|---|--|---|--|--|---|---|--|--|-----|
| <b>CZS</b>  | φ1 ~ φ20 | ● | ● | ● | ● | ○ |  |  |  |  | ○ | ○ |  | ● |  |  | ○ | ○ |  |  | 202 |
| <b>CXES</b> | φ1 ~ φ16 | ● | ● | ● | ● | ○ |  |  |  |  | ○ |   |  | ● |  |  | ○ | ○ |  |  | 216 |

### For Hard Materials

|            |          |  |  |   |   |   |   |   |  |  |  |  |  |  |  |  |  |  |  |  |     |
|------------|----------|--|--|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|-----|
| <b>HMS</b> | φ1 ~ φ12 |  |  | ○ | ● | ● | ● | ● |  |  |  |  |  |  |  |  |  |  |  |  | 238 |
|------------|----------|--|--|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|-----|

### For Aluminum Milling

|            |            |  |  |  |  |  |  |  |  |  |   |  |  |   |  |  |  |  |  |  |     |
|------------|------------|--|--|--|--|--|--|--|--|--|---|--|--|---|--|--|--|--|--|--|-----|
| <b>CAS</b> | φ0.5 ~ φ12 |  |  |  |  |  |  |  |  |  | ★ |  |  | ○ |  |  |  |  |  |  | 192 |
|------------|------------|--|--|--|--|--|--|--|--|--|---|--|--|---|--|--|--|--|--|--|-----|

### For Stainless Steel Milling

|              |          |   |   |   |  |  |  |  |  |  |   |  |  |   |  |  |   |   |  |  |     |
|--------------|----------|---|---|---|--|--|--|--|--|--|---|--|--|---|--|--|---|---|--|--|-----|
| <b>CEsus</b> | φ6 ~ φ12 | ● | ★ | ○ |  |  |  |  |  |  | ○ |  |  | ○ |  |  | ○ | ○ |  |  | 228 |
|--------------|----------|---|---|---|--|--|--|--|--|--|---|--|--|---|--|--|---|---|--|--|-----|

### For Copper Electrode Milling

|                    |            |  |  |  |  |  |  |  |  |  |   |  |  |   |   |  |  |  |  |  |     |
|--------------------|------------|--|--|--|--|--|--|--|--|--|---|--|--|---|---|--|--|--|--|--|-----|
| <b>CRN-ES 2000</b> | φ0.2 ~ φ12 |  |  |  |  |  |  |  |  |  | ○ |  |  | ★ | ○ |  |  |  |  |  | 186 |
| <b>CRN-ES 4000</b> | φ3 ~ φ12   |  |  |  |  |  |  |  |  |  | ○ |  |  | ★ | ○ |  |  |  |  |  | 232 |

### For Plastic Milling

|            |            |  |  |  |  |  |  |  |  |  |   |  |  |   |   |  |  |  |  |  |     |
|------------|------------|--|--|--|--|--|--|--|--|--|---|--|--|---|---|--|--|--|--|--|-----|
| <b>CPS</b> | φ0.3 ~ φ12 |  |  |  |  |  |  |  |  |  | ○ |  |  | ● | ★ |  |  |  |  |  | 190 |
|------------|------------|--|--|--|--|--|--|--|--|--|---|--|--|---|---|--|--|--|--|--|-----|

### For Graphite Milling

|                  |           |  |  |  |  |  |  |  |  |  |   |   |   |   |   |  |  |  |  |   |     |
|------------------|-----------|--|--|--|--|--|--|--|--|--|---|---|---|---|---|--|--|--|--|---|-----|
| <b>DCES 2000</b> | φ0.2 ~ φ6 |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ● |  |  |  |  | ○ | 188 |
| <b>DCES 4000</b> | φ3 ~ φ10  |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ● |  |  |  |  | ○ | 234 |
| <b>CGE</b>       | φ2 ~ φ20  |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ○ |  |  |  |  |   | 236 |

★ Highly Recommended ● Recommended ○ Suggested













# Tool Type

| Number of Flute | Appearance | Model Number | Coating | Helix Angle | Features |
|-----------------|------------|--------------|---------|-------------|----------|
|-----------------|------------|--------------|---------|-------------|----------|

## Long Neck Square

### Long Neck Square for Steels




#### High Precision, for Finishing

|          |   |                 |   |     |  |   |
|----------|---|-----------------|---|-----|--|---|
| 2 Flutes |  | <b>VHLS</b>     |  | 30° | V series $\phi 3$ shank x overall length 38<br>2 flute long neck square for Hard Materials | Negative rake angle  |
| 2 Flutes |  | <b>HLS 2000</b> |  | 30° | 2 flute long neck square for Hard Materials  | Negative rake angle  |
| 2 Flutes |  | <b>C-CER</b>    |  | 30° | From Raw Materials and SUS to 55HRC<br>2 flute long neck square                            | Positive rake angle  |
| 4 Flutes |  | <b>HLS 4000</b> |  | 30° | 4 flute long neck square for Hard Materials  | Negative rake angle  |



#### High Efficiency

|          |   |            |   |              |   |  |
|----------|---|------------|---|--------------|---|--|
| 4 Flutes |  | <b>CXS</b> |  | 37°<br>~ 40° | 4 flute highly efficient square with variable pitch and helix design<br>Effective length L/D=3~ about 5 times |  |
|----------|---|------------|---|--------------|---|--|

### Long Neck Square for Aluminum Milling

|          |   |                |   |     |  |  |
|----------|---|----------------|---|-----|--|--|
| 3 Flutes |  | <b>AZS</b>     | —   | 45° | NON-COAT 3 flute long neck square and enables vertical milling |  |
| 3 Flutes |  | <b>DLC-AZS</b> |  | 45° | AZS with DLC coating   |  |

### Long Neck Square for Plastic Milling


|          |   |             |   |     |   |  |
|----------|---|-------------|---|-----|---|--|
| 2 Flutes |  | <b>CPR</b>  | — | 30° | NON-COAT 2 flute long neck square             |  |
| 2 Flutes |  | <b>CPRL</b> | — | 30° | CPR with long shank<br>Long neck & long shank |  |

### Long Neck Square for Graphite Milling










|          |  |             |  |     |                                   |  |
|----------|--|-------------|--|-----|-----------------------------------|--|
| 2 Flutes |  | <b>DCLS</b> |  | 30° | DIA COAT 2 flute long neck square |  |
|----------|--|-------------|--|-----|-----------------------------------|--|

## Radius

### Radius for Steels

|          |   |              |   |     |          |  |
|----------|---|--------------|---|-----|----------|--|
| 2 Flutes |  | <b>C-CRS</b> |  | 30° | Standard | Neutral rake angle  |
|----------|---|--------------|---|-----|----------|--|

#### High Efficiency

|          |   |              |   |              |  |   |
|----------|---|--------------|---|--------------|--|---|
| 4 Flutes |  | <b>CXERS</b> |  | 37°<br>~ 40° | 4 flute highly efficient radius square with variable pitch and helix design<br>From Raw Materials and SUS to 55HRC | Positive rake angle  |
| 5 Flutes |  | <b>CXRS</b>  |  | 42°<br>~ 45° | 5 flute highly efficient radius square with variable pitch and helix design<br>From Raw Materials and SUS to 55HRC | Positive rake angle  |
| 4 Flutes |  | <b>CNRS</b>  |  | 45°          | 4 flute radius square with variable pitch and high helix<br>For Titanium Alloys and Heat Resistant Alloys milling  | Positive rake angle  |

#### For Hard Materials

|            |   |              |   |     |  |   |
|------------|---|--------------|---|-----|--|---|
| 4-6 Flutes |  | <b>HMERS</b> |  | 45° | For Hard Materials (~ 65HRC)<br>4-6 flute radius | Negative rake angle  |
|------------|---|--------------|---|-----|--|---|

| Model Number | Size | Carbon Steels | Alloy Steels<br>SUS | Prehardened<br>Steels | Hardened Steels |           |           |           |           | Cast Iron | Aluminum<br>Alloys | Graphite | Copper | Plastics | Glass Filled<br>Plastics | Titanium Alloys | Heat Resistant<br>Alloys | Cemented<br>Carbide | Hard Brake<br>(Non-Metallic) Materials | Page |
|--------------|------|---------------|---------------------|-----------------------|-----------------|-----------|-----------|-----------|-----------|-----------|--------------------|----------|--------|----------|--------------------------|-----------------|--------------------------|---------------------|--|------|
|              |      |               |                     |                       | 50<br>HRC       | 55<br>HRC | 60<br>HRC | 65<br>HRC | 70<br>HRC |           |                    |          |        |          |                          |                 |                          |                     |  |      |

### Long Neck Square

#### For Steels

##### High Precision, for Finishing

|                 |           |   |   |   |   |   |   |  |  |   |  |  |   |  |  |   |   |  |  |     |
|-----------------|-----------|---|---|---|---|---|---|--|--|---|--|--|---|--|--|---|---|--|--|-----|
| <b>VHLS</b>     | φ0.1 ~ φ2 | ○ | ○ | ● | ● | ● | ○ |  |  | ○ |  |  | ○ |  |  | ○ | ○ |  |  | 52  |
| <b>HLS 2000</b> | φ0.1 ~ φ6 | ○ | ○ | ● | ● | ● | ○ |  |  | ○ |  |  | ○ |  |  | ○ | ○ |  |  | 242 |
| <b>C-CER</b>    | φ0.1 ~ φ6 | ● | ● | ● | ● | ○ |   |  |  | ○ |  |  | ● |  |  | ○ | ○ |  |  | 256 |
| <b>HLS 4000</b> | φ1 ~ φ6   | ○ | ○ | ● | ● | ● | ○ |  |  | ○ |  |  | ○ |  |  | ○ | ○ |  |  | 288 |

##### High Efficiency

|            |          |   |   |   |   |   |  |  |  |   |  |  |   |  |  |   |   |  |  |     |
|------------|----------|---|---|---|---|---|--|--|--|---|--|--|---|--|--|---|---|--|--|-----|
| <b>CXS</b> | φ1 ~ φ12 | ● | ● | ● | ● | ○ |  |  |  | ○ |  |  | ● |  |  | ○ | ○ |  |  | 294 |
|------------|----------|---|---|---|---|---|--|--|--|---|--|--|---|--|--|---|---|--|--|-----|

#### For Aluminum Milling

|                |          |  |  |  |  |  |  |  |  |   |  |  |   |   |  |  |  |  |  |     |
|----------------|----------|--|--|--|--|--|--|--|--|---|--|--|---|---|--|--|--|--|--|-----|
| <b>AZS</b>     | φ1 ~ φ12 |  |  |  |  |  |  |  |  | ★ |  |  | ○ | ○ |  |  |  |  |  | 278 |
| <b>DLC-AZS</b> | φ1 ~ φ12 |  |  |  |  |  |  |  |  | ★ |  |  | ○ | ○ |  |  |  |  |  | 282 |

#### For Plastic Milling

|             |           |  |  |  |  |  |  |  |  |   |  |  |   |   |  |  |  |  |  |     |
|-------------|-----------|--|--|--|--|--|--|--|--|---|--|--|---|---|--|--|--|--|--|-----|
| <b>CPR</b>  | φ0.5 ~ φ6 |  |  |  |  |  |  |  |  | ○ |  |  | ● | ★ |  |  |  |  |  | 270 |
| <b>CPRL</b> | φ0.5 ~ φ4 |  |  |  |  |  |  |  |  | ○ |  |  | ● | ★ |  |  |  |  |  | 274 |

#### For Graphite Milling

|             |           |  |  |  |  |  |  |  |  |   |   |  |   |   |   |  |  |  |   |     |
|-------------|-----------|--|--|--|--|--|--|--|--|---|---|--|---|---|---|--|--|--|---|-----|
| <b>DCLS</b> | φ0.4 ~ φ6 |  |  |  |  |  |  |  |  | ○ | ★ |  | ○ | ○ | ● |  |  |  | ○ | 266 |
|-------------|-----------|--|--|--|--|--|--|--|--|---|---|--|---|---|---|--|--|--|---|-----|

### Radius

#### For Steels

|              |          |   |   |   |   |   |  |  |  |   |  |  |   |  |  |   |   |  |  |     |
|--------------|----------|---|---|---|---|---|--|--|--|---|--|--|---|--|--|---|---|--|--|-----|
| <b>C-CRS</b> | φ1 ~ φ12 | ● | ● | ● | ● | ● |  |  |  | ○ |  |  | ● |  |  | ○ | ○ |  |  | 302 |
|--------------|----------|---|---|---|---|---|--|--|--|---|--|--|---|--|--|---|---|--|--|-----|

##### High Efficiency

|              |          |   |   |   |   |   |  |  |  |   |   |  |   |  |  |   |   |  |  |     |
|--------------|----------|---|---|---|---|---|--|--|--|---|---|--|---|--|--|---|---|--|--|-----|
| <b>CXERS</b> | φ1 ~ φ12 | ● | ● | ● | ● | ● |  |  |  | ○ |   |  | ● |  |  | ○ | ○ |  |  | 310 |
| <b>CXRS</b>  | φ3 ~ φ12 | ● | ● | ● | ● | ● |  |  |  | ○ | ○ |  | ● |  |  | ○ | ○ |  |  | 316 |
| <b>CNRS</b>  | φ6 ~ φ12 | ● | ● | ● | ● | ● |  |  |  | ○ | ○ |  | ● |  |  | ★ | ★ |  |  | 306 |

#### For Hard Materials

|              |          |  |  |   |   |   |   |   |  |  |  |  |  |  |  |  |  |  |  |     |
|--------------|----------|--|--|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|-----|
| <b>HMERS</b> | φ3 ~ φ12 |  |  | ○ | ● | ● | ● | ● |  |  |  |  |  |  |  |  |  |  |  | 320 |
|--------------|----------|--|--|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|-----|

★ Highly Recommended ● Recommended ○ Suggested















# Tool Type

| Number of Flute | Appearance | Model Number | Coating | Helix Angle | Features |
|-----------------|------------|--------------|---------|-------------|----------|
|-----------------|------------|--------------|---------|-------------|----------|
















## Long Neck Radius

### Long Neck Radius for Steels

#### High Precision, for Finishing

|          |   |                    |   |     |  |   |
|----------|---|--------------------|---|-----|--|---|
| 2 Flutes |  | <b>VHLRS</b>       |  | 30° | V series $\phi 3$ shank x overall length 38<br>2 flute long neck radius for Hard Materials | Negative rake angle        |
| 2 Flutes |  | <b>HLRS 2000/E</b> |  | 30° | 2 flute long neck radius for Hard Materials  | Negative rake angle        |
| 4 Flutes |  | <b>HGLRS</b>       |  | 30° | For Hard Materials (~ 70HRC)<br>4 flute long neck radius                                   | Super negative rake angle  |
| 4 Flutes |  | <b>HLRS 4000</b>   |  | 30° | 4 flute long neck radius for Hard Materials  | Negative rake angle        |




#### High Efficiency

|            |   |               |   |              |  |   |
|------------|---|---------------|---|--------------|--|---|
| 4 Flutes   |  | <b>HRRS</b>   |  | 45°          | 4 flute highly efficient long neck radius with variable pitch and back taper geometry                              | Negative rake angle        |
| 4 Flutes   |  | <b>HRRS-S</b> |  | 45°          | HRRS with short shank  | Negative rake angle        |
| 4 Flutes   |  | <b>CRRS</b>   |  | 45°          | From Raw Materials and SUS to 55HRC<br>4 flute highly efficient long neck radius with effective length L/D=3 times | Positive rake angle        |
| 5 Flutes   |  | <b>CXLRS</b>  |  | 42°<br>~ 45° | Effective length L/D=3-4 times<br>5 flute highly efficient long neck radius with variable pitch and helix design   | Positive rake angle        |
| 5-6 Flutes |  | <b>HGRRS</b>  |  | 45°          | For Hard Materials (~70HRC)<br>5-6 flute highly efficient long neck radius with effective length L/D=3 times       | Super negative rake angle  |

#### High Rigidity

|            |   |             |   |              |  |   |
|------------|---|-------------|---|--------------|--|---|
| 4-6 Flutes |  | <b>HHRS</b> |  | 30°<br>& 45° | For Hard Materials<br>4-6 flute long neck radius with effective length L/D=3 times | Positive rake angle  |
|------------|---|-------------|---|--------------|--|---|








### CBN Long Neck Radius

|          |   |                     |   |    |   |  |
|----------|---|---------------------|---|----|---|--|
| 1 Flute  |  | <b>CBN-RSF</b>      | — | 0° | SF series provides excellent surface finish<br>1 flute long neck radius |  |
| 2 Flutes |  | <b>CBN-LRF 2000</b> | — | 0° | High rigidity and long tool life<br>2 flute long neck radius            |  |
| 4 Flutes |  | <b>CBN-LRF 4000</b> | — | 0° | High rigidity and long tool life<br>4 flute long neck radius            |  |

### Long Neck Radius for Graphite Milling

|          |   |              |   |     |                                   |  |
|----------|---|--------------|---|-----|-----------------------------------|--|
| 4 Flutes |  | <b>DCLRS</b> |  | 30° | DIA COAT 4 flute long neck radius |  |
|----------|---|--------------|---|-----|-----------------------------------|--|

### UDC Long Neck Radius for Cemented Carbide and Hard Brittle Materials

|             |   |                |   |     |  |  |
|-------------|---|----------------|---|-----|--|--|
| 1 Flute     |  | <b>UPDLRS</b>  | —   | 0°  | 1 flute long neck radius with binderless PCD<br>After milling with UDC, improve mirror surface finish by using UPD |  |
| 2 Flutes    |  | <b>UDCLRSF</b> |  | 0°  | Excellent surface quality<br>2 flute long neck radius  |  |
| 2 Flutes    |  | <b>UDCLRS</b>  |  | 0°  | Lower costs<br>2 flute long neck radius  |  |
| 6-10 Flutes |  | <b>UDCRRS</b>  |  | 40° | For roughing<br>6-10 flute highly efficient long neck radius   |  |

## Taper Neck Radius

### Taper Neck Radius for Steels

|          |   |              |   |     |   |   |
|----------|---|--------------|---|-----|---|---|
| 4 Flutes |  | <b>HTNRS</b> |  | 45° | 4 flute taper neck radius for Hard Materials<br>Variable pitch & high helix & back taper geometry | Negative rake angle  |
|----------|---|--------------|---|-----|---|---|

| Model Number | Size | Carbon Steels | Alloy Steels<br>SUS | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials | Page |
|--------------|------|---------------|---------------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|------|
|              |      |               |                     |                    | 50 HRC          | 55 HRC | 60 HRC | 65 HRC | 70 HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |      |

### Long Neck Radius

#### For Steels

##### High Precision, for Finishing

|                     |           |   |   |   |   |   |   |   |   |   |  |  |   |  |  |   |   |  |  |     |
|---------------------|-----------|---|---|---|---|---|---|---|---|---|--|--|---|--|--|---|---|--|--|-----|
| <b>VHLRS</b>        | φ0.2 ~ φ2 | ○ | ○ | ● | ● | ● | ● | ○ |   | ○ |  |  | ● |  |  | ○ | ○ |  |  | 55  |
| <b>HRLRS 2000/E</b> | φ0.2 ~ φ6 | ○ | ○ | ● | ● | ● | ● | ○ |   | ○ |  |  | ● |  |  | ○ | ○ |  |  | 324 |
| <b>HGLRS</b>        | φ0.2 ~ φ6 |   |   | ○ | ● | ● | ● | ★ | ★ |   |  |  |   |  |  |   |   |  |  | 344 |
| <b>HRLRS 4000</b>   | φ0.2 ~ φ6 | ○ | ○ | ● | ● | ● | ● | ○ |   | ○ |  |  | ○ |  |  | ○ | ○ |  |  | 358 |

##### High Efficiency

|               |          |   |   |   |   |   |   |   |   |   |   |  |   |  |  |   |   |  |  |     |
|---------------|----------|---|---|---|---|---|---|---|---|---|---|--|---|--|--|---|---|--|--|-----|
| <b>HRRS</b>   | φ2 ~ φ12 |   |   | ● | ● | ● | ● | ○ |   | ○ |   |  |   |  |  |   |   |  |  | 382 |
| <b>HRRS-S</b> | φ2 ~ φ12 |   |   | ● | ● | ● | ● | ○ |   | ○ |   |  |   |  |  |   |   |  |  | 388 |
| <b>CRRS</b>   | φ2 ~ φ12 | ● | ● | ● | ● |   |   |   |   | ○ | ○ |  | ● |  |  | ● | ● |  |  | 390 |
| <b>CXLRs</b>  | φ3 ~ φ12 | ● | ● | ● | ● |   |   |   |   | ○ | ○ |  | ● |  |  | ○ | ○ |  |  | 400 |
| <b>HGRRS</b>  | φ2 ~ φ12 |   |   | ○ | ● | ● | ★ | ● | ● |   |   |  |   |  |  |   |   |  |  | 408 |

##### High Rigidity

|             |          |   |   |   |   |   |   |  |  |   |  |  |   |  |  |   |   |  |  |     |
|-------------|----------|---|---|---|---|---|---|--|--|---|--|--|---|--|--|---|---|--|--|-----|
| <b>HHRS</b> | φ3 ~ φ12 | ○ | ○ | ● | ● | ● | ○ |  |  | ○ |  |  | ○ |  |  | ○ | ○ |  |  | 404 |
|-------------|----------|---|---|---|---|---|---|--|--|---|--|--|---|--|--|---|---|--|--|-----|

#### CBN

|                     |           |  |  |   |   |   |   |   |   |  |  |  |  |  |  |  |  |  |  |     |
|---------------------|-----------|--|--|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|-----|
| <b>CBN-RSF</b>      | φ0.2 ~ φ2 |  |  |   |   |   | ● | ● |   |  |  |  |  |  |  |  |  |  |  | 132 |
| <b>CBN-LRF 2000</b> | φ0.1 ~ φ3 |  |  | ○ | ● | ● | ● | ● | ● |  |  |  |  |  |  |  |  |  |  | 136 |
| <b>CBN-LRF 4000</b> | φ0.1 ~ φ2 |  |  | ○ | ● | ● | ● | ● | ● |  |  |  |  |  |  |  |  |  |  | 146 |

#### For Graphite Milling

|              |         |  |  |  |  |  |  |  |  |   |   |   |   |   |  |  |  |  |   |     |
|--------------|---------|--|--|--|--|--|--|--|--|---|---|---|---|---|--|--|--|--|---|-----|
| <b>DCLRS</b> | φ1 ~ φ6 |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ● |  |  |  |  | ○ | 396 |
|--------------|---------|--|--|--|--|--|--|--|--|---|---|---|---|---|--|--|--|--|---|-----|

#### UDC for Cemented Carbide and Hard Brittle Materials

|                |            |  |  |  |  |  |  |  |  |  |  |  |  |   |   |  |  |   |   |     |
|----------------|------------|--|--|--|--|--|--|--|--|--|--|--|--|---|---|--|--|---|---|-----|
| <b>UPDLRS</b>  | φ0.2 ~ φ2  |  |  |  |  |  |  |  |  |  |  |  |  |   |   |  |  | ★ | ● | 108 |
| <b>UDCLRSF</b> | φ0.25 ~ φ2 |  |  |  |  |  |  |  |  |  |  |  |  |   | ○ |  |  | ★ | ● | 90  |
| <b>UDCLRS</b>  | φ0.3 ~ φ2  |  |  |  |  |  |  |  |  |  |  |  |  |   | ○ |  |  | ★ | ● | 98  |
| <b>UDCRRS</b>  | φ2 ~ φ6    |  |  |  |  |  |  |  |  |  |  |  |  | ○ |   |  |  | ★ | ● | 104 |

### Taper Neck Radius

#### For Steels

|              |         |  |  |   |   |   |   |   |  |   |  |  |  |  |  |  |  |  |  |     |
|--------------|---------|--|--|---|---|---|---|---|--|---|--|--|--|--|--|--|--|--|--|-----|
| <b>HTNRS</b> | φ1 ~ φ6 |  |  | ● | ● | ● | ● | ○ |  | ○ |  |  |  |  |  |  |  |  |  | 412 |
|--------------|---------|--|--|---|---|---|---|---|--|---|--|--|--|--|--|--|--|--|--|-----|






















★ Highly Recommended ● Recommended ○ Suggested

# Tool Type

| Number of Flute | Appearance | Model Number | Coating | Helix Angle | Features |
|-----------------|------------|--------------|---------|-------------|----------|
|-----------------|------------|--------------|---------|-------------|----------|

## Ball

### Ball for Steels

|          |   |              |   |     |   |   |
|----------|---|--------------|---|-----|---|---|
| 2 Flutes |  | <b>HGB</b>   |  | 30° | For Hard Materials (~ 70HRC)<br>2 flute ball  | Super negative rake angle  |
| 2 Flutes |  | <b>HSB</b>   |  | 30° | 2 flute ball for Hard Materials<br>The most popular multi-purpose tool                                    | Negative rake angle        |
| 2 Flutes |  | <b>HSB-S</b> |  | 30° | HSB with short shank  | Negative rake angle        |
| 2 Flutes |  | <b>CSEB</b>  |  | 30° | Standard 2 flute ball<br>Excellent surface quality  | Neutral rake angle         |
| 3 Flutes |  | <b>CFB</b>   |  | 30° | From Raw Materials, SUS, Aluminum to 55HRC<br>3 flute highly efficient ball for excellent surface quality | Positive rake angle        |
| 4 Flutes |  | <b>HFB</b>   |  | 40° | 4 flute ball for Hard Materials<br>High feed and highly efficient milling                                 | Negative rake angle        |
| 4 Flutes |  | <b>HFB-S</b> |  | 40° | HFB with short shank  | Negative rake angle        |





### Long Shank Ball

|          |   |            |   |     |  |   |
|----------|---|------------|---|-----|--|---|
| 2 Flutes |  | <b>HBL</b> |  | 30° | HB with long shank<br>2 flute long shank ball (straight shank) | Positive rake angle  |
|----------|---|------------|---|-----|--|---|







### Ball for Aluminum Milling

|          |   |                |   |     |                          |  |
|----------|---|----------------|---|-----|--------------------------|--|
| 3 Flutes |  | <b>DLC-CFB</b> |  | 30° | DLC coating 3 flute ball |  |
|----------|---|----------------|---|-----|--------------------------|--|

### Ball for Graphite Milling













|          |   |                 |   |     |                       |  |
|----------|---|-----------------|---|-----|-----------------------|--|
| 2 Flutes |    | <b>DCB</b>      |  | 35° | DIA COAT 2 flute ball |  |
| 2 Flutes |   | <b>CGB 2000</b> | —   | 35° | NON-COAT 2 flute ball |  |
| 4 Flutes |  | <b>CGB 4000</b> | —   | 35° | NON-COAT 4 flute ball |  |

### UDC Ball for Cemented Carbide and Hard Brittle Materials

|          |   |              |   |    |   |  |
|----------|---|--------------|---|----|---|--|
| 2 Flutes |  | <b>UDCBH</b> |  | 0° | High efficiency<br>2 flute ball           |  |
| 2 Flutes |  | <b>UDCBF</b> |  | 0° | 2 flute ball for excellent surface finish |  |
| 2 Flutes |  | <b>UDCB</b>  |  | 0° | Lower costs<br>2 flute ball               |  |

## Long Neck Ball

### Long Neck Ball for Steels

|          |   |              |   |     |  |   |
|----------|---|--------------|---|-----|--|---|
| 2 Flutes |  | <b>VHGLB</b> |  | 30° | V series $\phi 3$ shank x overall length 38<br>2 flute long neck ball for Hard Materials | Super negative rake angle  |
| 2 Flutes |  | <b>HGLB</b>  |  | 30° | For Hard Materials (~ 70HRC)<br>2 flute long neck ball                                   | Super negative rake angle  |
| 2 Flutes |  | <b>HWLB</b>  |  | 30° | 2 flute long neck ball for Hard Materials<br>Using upgraded version of HARDMAX coating   | Negative rake angle        |
| 2 Flutes |  | <b>VHSLB</b> |  | 30° | V series $\phi 3$ shank x overall length 38<br>2 flute long neck ball for Hard Materials | Negative rake angle        |

| Model Number | Size | Carbon Steels | Alloy Steels<br>SUS | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials | Page |
|--------------|------|---------------|---------------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|------|
|              |      |               |                     |                    | 50 HRC          | 55 HRC | 60 HRC | 65 HRC | 70 HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |      |

### Ball

| For Steels  |            | Carbon Steels | Alloy Steels<br>SUS | Prehardened Steels | 50 HRC | 55 HRC | 60 HRC | 65 HRC | 70 HRC | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials | Page |
|---|------------|---------------|---------------------|--------------------|--------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|------|
| <b>HGB</b>  | R0.05 ~ R3 |               |                     | ○                  | ●      | ●      | ●      | ★      | ★      |           |                 |          |        |          |                       |                 |                       |                  |                                       | 422  |
| <b>HSB</b>  | R0.03 ~ R6 | ○             | ○                   | ●                  | ●      | ●      | ●      | ○      |        | ○         |                 |          | ○      |          |                       | ○               | ○                     |                  |                                       | 424  |
| <b>HSB-S</b>  | R0.1 ~ R2  | ○             | ○                   | ●                  | ●      | ●      | ●      | ○      |        | ○         |                 |          | ○      |          |                       | ○               | ○                     |                  |                                       | 428  |
| <b>CSEB</b>   | R0.05 ~ R6 | ●             | ●                   | ●                  | ●      | ●      |        |        |        | ○         | ●               |          | ●      |          |                       | ○               | ○                     |                  |                                       | 432  |
| <b>CFB</b>  | R0.3 ~ R6  | ●             | ●                   | ●                  | ●      | ●      |        |        |        | ○         | ●               |          | ●      | ○        |                       | ●               | ●                     |                  |                                       | 442  |
| <b>HFB</b>  | R1 ~ R6    |               |                     |                    | ●      | ●      | ●      | ●      | ●      |           |                 |          |        |          |                       |                 |                       |                  |                                       | 452  |
| <b>HFB-S</b>  | R1 ~ R6    |               |                     |                    | ●      | ●      | ●      | ●      | ●      |           |                 |          |        |          |                       |                 |                       |                  |                                       | 453  |
| Long Shank  |            |               |                     |                    |        |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |      |
| <b>HBL</b>  | R1.5 ~ R6  | ○             | ○                   | ●                  | ●      | ●      | ○      |        |        | ○         |                 |          | ●      |          |                       | ○               | ○                     |                  |                                       | 430  |
| For Aluminum Milling                                |            |               |                     |                    |        |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |      |
| <b>DLC-CFB</b>                                      | R0.3 ~ R6  |               |                     |                    |        |        |        |        |        |           | ★               |          | ○      | ○        |                       |                 |                       |                  |                                       | 448  |
| For Graphite Milling                                |            |               |                     |                    |        |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |      |
| <b>DCB</b>  | R0.5 ~ R6  |               |                     |                    |        |        |        |        |        |           | ○               | ★        | ○      | ○        | ●                     |                 |                       |                  | ○                                     | 438  |
| <b>CGB 2000</b>                                     | R0.2 ~ R6  |               |                     |                    |        |        |        |        |        |           | ○               | ★        | ○      | ○        | ○                     |                 |                       |                  |                                       | 440  |
| <b>CGB 4000</b>                                     | R2 ~ R10   |               |                     |                    |        |        |        |        |        |           | ○               | ★        | ○      | ○        | ○                     |                 |                       |                  |                                       | 458  |
| UDC for Cemented Carbide and Hard Brittle Materials |            |               |                     |                    |        |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |      |
| <b>UDCBH</b>  | R0.3 ~ R1  |               |                     |                    |        |        |        |        |        |           |                 |          |        |          | ○                     |                 |                       | ★                | ●                                     | 68   |
| <b>UDCBF</b>  | R0.1 ~ R3  |               |                     |                    |        |        |        |        |        |           |                 |          |        |          | ○                     |                 |                       | ★                | ●                                     | 70   |
| <b>UDCB</b>   | R0.1 ~ R3  |               |                     |                    |        |        |        |        |        |           |                 |          |        |          | ○                     |                 |                       | ★                | ●                                     | 72   |











### Long Neck Ball




| For Steels   |              | Carbon Steels | Alloy Steels<br>SUS | Prehardened Steels | 50 HRC | 55 HRC | 60 HRC | 65 HRC | 70 HRC | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials | Page |
|--------------|--------------|---------------|---------------------|--------------------|--------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|------|
| <b>VHGLB</b> | R0.05 ~ R1.5 |               |                     | ○                  | ●      | ●      | ●      | ★      | ★      |           |                 |          |        |          |                       |                 |                       |                  |                                       | 34   |
| <b>HGLB</b>  | R0.05 ~ R3   |               |                     | ○                  | ●      | ●      | ●      | ★      | ★      |           |                 |          |        |          |                       |                 |                       |                  |                                       | 460  |
| <b>HWLB</b>  | R0.25 ~ R1   | ○             | ○                   | ●                  | ★      | ★      | ★      | ●      | ●      | ○         |                 |          | ○      |          |                       | ○               | ○                     |                  |                                       | 470  |
| <b>VHSLB</b> | R0.05 ~ R1.5 | ○             | ○                   | ●                  | ●      | ●      | ●      | ○      |        | ○         |                 |          | ○      |          |                       | ○               | ○                     |                  |                                       | 37   |


★ Highly Recommended ● Recommended ○ Suggested

# Tool Type

| Number of Flute | Appearance | Model Number | Coating | Helix Angle | Features |
|-----------------|------------|--------------|---------|-------------|----------|
|-----------------|------------|--------------|---------|-------------|----------|





| Long Neck Ball for Steels |   |               |                 |     |  |   |
|---------------------------|---|---------------|-----------------|-----|--|---|
| 2 Flutes                  |  | <b>HSLB</b>   | <b>HARD MAX</b> | 30° | 2 flute long neck ball for Hard Materials<br>The most popular multi-purpose tool                   | Negative rake angle  |
| 2 Flutes                  |  | <b>HSLB-S</b> | <b>HARD MAX</b> | 30° | HSLB with short shank  | Negative rake angle  |
| 2 Flutes                  |  | <b>VCSELB</b> | <b>UT COAT</b>  | 30° | V series $\phi 3$ shank x overall length 38<br>Standard 2 flute long neck ball                     | Neutral rake angle   |
| 2 Flutes                  |  | <b>CSELB</b>  | <b>UT COAT</b>  | 30° | Standard 2 flute long neck ball<br>Excellent surface quality                                       | Neutral rake angle   |
| 3 Flutes                  |  | <b>CFLB</b>   | <b>UT COAT</b>  | 30° | From Raw Materials, SUS, Aluminum to 55HRC<br>3 flute long neck ball for excellent surface quality | Positive rake angle  |

| CBN Long Neck Ball |   |                 |   |     |  |  |
|--------------------|---|-----------------|---|-----|--|--|
| 2 Flutes           |  | <b>CBN-PLB</b>  | — | 0°  | For super mirror milling (burnishing effect)<br>2 flute long neck ball |  |
| 2 Flutes           |  | <b>CBN-LBSF</b> | — | 20° | Excellent surface quality<br>2 flute long neck ball                    |  |
| 2 Flutes           |  | <b>CBN-LBF</b>  | — | 0°  | High rigidity and long tool life<br>2 flute long neck ball             |  |




| Long Neck Ball for Copper Electrode Milling |   |              |            |     |   |   |
|---|---|--------------|------------|-----|---|---|
| 2 Flutes                                    |  | <b>VDCLB</b> | <b>DLC</b> | 30° | V series $\phi 3$ shank x overall length 38<br>DLC coating 2 flute long neck ball | Positive rake angle  |
| 2 Flutes                                    |  | <b>DLCLB</b> | <b>DLC</b> | 30° | DLC coating 2 flute long neck ball  | Positive rake angle  |


| Long Neck Ball for Plastic Milling |   |             |   |     |                                 |  |
|------------------------------------|---|-------------|---|-----|---------------------------------|--|
| 2 Flutes                           |  | <b>CPRB</b> | — | 30° | NON-COAT 2 flute long neck ball |  |

| Long Neck Ball for Graphite Milling |   |             |            |     |                                 |  |
|-------------------------------------|---|-------------|------------|-----|---------------------------------|--|
| 2 Flutes                            |  | <b>DCLB</b> | <b>DIA</b> | 35° | DIA COAT 2 flute long neck ball |  |

| UDC Long Neck Ball for Cemented Carbide and Hard Brittle Materials |   |               |            |    |  |  |
|--|---|---------------|------------|----|--|--|
| 1 Flute  |  | <b>UPDLB</b>  | —          | 0° | 1 flute long neck ball with binderless PCD<br>After milling with UDC, improve mirror surface finish by using UPD |  |
| 2 Flutes   |  | <b>UDCLBH</b> | <b>UDC</b> | 0° | High efficiency<br>2 flute long neck ball  |  |
| 2 Flutes   |  | <b>UDCLBF</b> | <b>UDC</b> | 0° | For finishing<br>2 flute long neck ball  |  |
| 2 Flutes   |  | <b>UDCLB</b>  | <b>UDC</b> | 0° | Lower costs<br>2 flute long neck ball  |  |

## Taper Neck Ball

| Taper Neck Ball for Steels |   |              |                 |     |   |   |
|----------------------------|---|--------------|-----------------|-----|---|---|
| 2 Flutes                   |  | <b>HTNB</b>  | <b>HARD MAX</b> | 30° | 2 flute taper neck ball                       | Positive rake angle  |
| 3 Flutes                   |  | <b>HFTNB</b> | <b>HARD MAX</b> | 40° | For Hard Materials<br>3 flute taper neck ball | Negative rake angle  |

| Taper Neck Ball for Graphite Milling |   |              |            |     |                                  |  |
|--------------------------------------|---|--------------|------------|-----|----------------------------------|--|
| 2 Flutes                             |  | <b>DCTNB</b> | <b>DIA</b> | 35° | DIA COAT 2 flute taper neck ball |  |



| Model Number | Size | Carbon Steels | Alloy Steels<br>SUS | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials | Page |
|--------------|------|---------------|---------------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|------|
|              |      |               |                     |                    | 50 HRC          | 55 HRC | 60 HRC | 65 HRC | 70 HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |      |

| For Steels  |              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |     |
|---|--------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----|
| <b>HSLB</b>   | R0.05 ~ R3   | ○ | ○ | ● | ● | ● | ● | ○ |   | ○ |   |   | ○ |   |   | ○ | ○ |   |   | 476 |
| <b>HSLB-S</b>                                       | R0.1 ~ R3    | ○ | ○ | ● | ● | ● | ● | ○ |   | ○ |   |   | ○ |   |   | ○ | ○ |   |   | 492 |
| <b>VCSELB</b>                                       | R0.05 ~ R1.5 | ● | ● | ● | ● | ● |   |   |   | ○ | ● |   | ● |   |   | ○ | ○ |   |   | 44  |
| <b>CSELB</b>  | R0.05 ~ R3   | ● | ● | ● | ● | ● |   |   |   | ○ | ● |   | ● |   |   | ○ | ○ |   |   | 496 |
| <b>CFLB</b>   | R0.3 ~ R3    | ● | ● | ● | ● | ● |   |   |   | ○ | ● |   | ● | ○ |   | ● | ● |   |   | 530 |
| CBN   |              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |     |
| <b>CBN-PLB</b>                                      | R0.2 ~ R0.5  |   |   | ○ | ● | ● | ● | ● | ● |   |   |   |   |   |   |   |   |   |   | 120 |
| <b>CBN-LBSF</b>                                     | R0.05 ~ R1   |   |   | ○ | ● | ● | ● | ● | ● |   |   |   |   |   |   |   |   |   |   | 122 |
| <b>CBN-LBF</b>                                      | R0.05 ~ R2   |   |   | ○ | ● | ● | ● | ● | ● |   |   |   |   |   |   |   |   |   |   | 126 |
| For Copper Electrode Milling                        |              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |     |
| <b>VDCLB</b>  | R0.05 ~ R1   |   |   |   |   |   |   |   |   |   | ● |   | ★ |   |   |   |   |   |   | 48  |
| <b>DLCLB</b>  | R0.05 ~ R3   |   |   |   |   |   |   |   |   |   | ● |   | ★ |   |   |   |   |   |   | 516 |
| For Plastic Milling                                 |              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |     |
| <b>CPRB</b>   | R0.2 ~ R3    |   |   |   |   |   |   |   |   |   | ○ |   | ● | ★ |   |   |   |   |   | 526 |
| For Graphite Milling                                |              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |     |
| <b>DCLB</b>   | R0.2 ~ R3    |   |   |   |   |   |   |   |   |   | ○ | ★ | ○ | ○ | ● |   |   |   | ○ | 512 |
| UDC for Cemented Carbide and Hard Brittle Materials |              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |     |
| <b>UPDLB</b>  | R0.1 ~ R1    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | ★ | ● | 88  |
| <b>UDCLBH</b>                                       | R0.3 ~ R1    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | ★ | ● | 76  |
| <b>UDCLBF</b>                                       | R0.1 ~ R3    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | ★ | ● | 80  |
| <b>UDCLB</b>  | R0.1 ~ R3    |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | ★ | ● | 84  |

### Taper Neck Ball

| For Steels           |           |   |   |   |   |   |   |   |  |   |   |   |   |   |   |   |   |  |   |     |
|----------------------|-----------|---|---|---|---|---|---|---|--|---|---|---|---|---|---|---|---|--|---|-----|
| <b>HTNB</b>          | R0.1 ~ R2 | ○ | ○ | ● | ● | ● | ● | ● |  | ○ |   |   | ● |   |   | ○ | ○ |  |   | 536 |
| <b>HFTNB</b>         | R0.5 ~ R2 | ○ | ○ | ● | ● | ● | ● | ● |  | ○ |   |   |   |   |   | ○ | ○ |  |   | 558 |
| For Graphite Milling |           |   |   |   |   |   |   |   |  |   |   |   |   |   |   |   |   |  |   |     |
| <b>DCTNB</b>         | R0.5 ~ R1 |   |   |   |   |   |   |   |  |   | ○ | ★ | ○ | ○ | ● |   |   |  | ○ | 556 |





★ Highly Recommended ● Recommended ○ Suggested

# Tool Type







| Number of Flute | Appearance | Model Number | Coating | Helix Angle | Features |
|-----------------|------------|--------------|---------|-------------|----------|
|-----------------|------------|--------------|---------|-------------|----------|

## Taper / Barrel / Chamfering / Drill

### Taper

|          |   |                   |   |     |   |
|----------|---|-------------------|---|-----|---|
| 2 Flutes |  | <b>C-CTE 2000</b> |  | 30° | 2 flute taper end mill<br>Half included angle 30°~15° |
| 4 Flutes |  | <b>C-CTE 4000</b> |  | 30° | 4 flute taper end mill<br>Half included angle 30°~7°  |

### Barrel Form




|          |   |             |   |   |  |
|----------|---|-------------|---|---|--|
| 4 Flutes |  | <b>COVB</b> |  | — | Oval barrel form<br>Suitable for narrow area with small inclined angle                     |
| 4 Flutes |  | <b>CSTB</b> |  | — | Standard taper barrel form<br>Suitable for highly efficient finishing with larger barrel R |
| 4 Flutes |  | <b>CWTB</b> |  | — | Wide taper barrel form<br>Suitable for finishing with wide taper angle                     |

### NON-COAT for Chamfering



|          |   |           |   |     |   |
|----------|---|-----------|---|-----|---|
| 2 Flutes |  | <b>SV</b> | — | 30° | NON-COAT and half included angle 45°<br>Peripheral spiral shape designed for reducing burrs |
|----------|---|-----------|---|-----|---|

### Drill







Over All Length 38.1 x Shank Diameter 3.175 mm  
P Series Micro Diameter Drill / Chamfering Cutter and Center Drill

|          |   |                |   |    |  |                     |
|----------|---|----------------|---|----|--|---------------------|
| 2 Flutes |  | <b>PMD STD</b> | — | —  | NON-COAT micro diameter drill<br>Flute length L/D=10 times                   | 4-facet drill point |
| 2 Flutes |  | <b>PMD PLT</b> | — | —  | NON-COAT micro diameter drill for pilot drilling<br>Flute length L/D=2 times | 4-facet drill point |
| 1 Flute  |  | <b>PSM</b>     | — | 0° | NON-COAT chamfering, counter sink, and center drill<br>Taper angle 45°       | —                   |





### Flat Drill

|          |   |             |   |     |   |                  |
|----------|---|-------------|---|-----|---|------------------|
| 2 Flutes |  | <b>UTDF</b> |  | 30° | Size M4 - M12 for drilling pilot holes before tapping | Point angle 180° |
|----------|---|-------------|---|-----|---|------------------|

### Carbide Drill

|          |   |              |   |     |   |                                |
|----------|---|--------------|---|-----|---|--------------------------------|
| 2 Flutes |  | <b>UTDSX</b> |  | 30° | Short slot length L/D=5 times<br>Diameter tolerance 0/-0.01 | Point angle 130°<br>X thinning |
| 2 Flutes |  | <b>C-UMD</b> |  | 24° | Medium slot length<br>Diameter tolerance 0/-0.01            | Point angle 150°               |
| 2 Flutes |  | <b>UTDLX</b> |  | 30° | Long slot length L/D=15 times<br>Diameter tolerance 0/-0.01 | Point angle 130°<br>X thinning |

### UDC Drill / Thread Mills

|          |   |              |   |     |  |
|----------|---|--------------|---|-----|--|
| 2 Flutes |  | <b>UDCMX</b> |  | 30° | For Cemented Carbide and Hard Brittle Materials<br>Drill       |
| 2 Flutes |  | <b>UDCT</b>  |  | —   | For Cemented Carbide and Hard Brittle Materials<br>Thread mill |

| Model Number | Size | Carbon Steels | Alloy Steels<br>SUS | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Heat Treat (Non-Metallic) Materials | Page |
|--------------|------|---------------|---------------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|-------------------------------------|------|
|              |      |               |                     |                    | 50 HRC          | 55 HRC | 60 HRC | 65 HRC | 70 HRC |           |                 |          |        |          |                       |                 |                       |                  |                                     |      |

### Taper / Barrel / Chamfering / Drill

| Taper  |                              |   |   |   |   |   |  |  |  |  |  |   |   |   |   |  |   |   |   |     |     |
|--|------------------------------|---|---|---|---|---|--|--|--|--|--|---|---|---|---|--|---|---|---|-----|-----|
| <b>C-CTE 2000</b>  | φ0.2 ~ φ2.5                  | ● | ● | ● | ● | ● |  |  |  |  |  | ○ |   |   |   |  | ○ |   |   | 564 |     |
| <b>C-CTE 4000</b>  | φ3 ~ φ10                     | ● | ● | ● | ● | ● |  |  |  |  |  | ○ |   |   |   |  | ○ |   |   | 568 |     |
| Barrel Form  |                              |   |   |   |   |   |  |  |  |  |  |   |   |   |   |  |   |   |   |     |     |
| <b>COVB</b>  | Tip R1 and R2                | ● | ● | ● | ● | ● |  |  |  |  |  | ○ | ● |   |   |  | ○ | ○ |   | 572 |     |
| <b>CSTB</b>  | Tip R1 ~ R3                  | ● | ● | ● | ● | ● |  |  |  |  |  | ○ | ● |   |   |  | ○ | ○ |   | 574 |     |
| <b>CWTB</b>  | Tip R1                       | ● | ● | ● | ● | ● |  |  |  |  |  | ○ | ● |   |   |  | ○ | ○ |   | 576 |     |
| NON-COAT for Chamfering  |                              |   |   |   |   |   |  |  |  |  |  |   |   |   |   |  |   |   |   |     |     |
| <b>SV</b>  | φ3 ~ φ12                     | ● | ● | ● |   |   |  |  |  |  |  | ○ | ○ | ○ | ○ |  |   |   |   | 578 |     |
| Drill  |                              |   |   |   |   |   |  |  |  |  |  |   |   |   |   |  |   |   |   |     |     |
| P Series Over All Length 38.1 x Shank Diameter 3.175 mm<br>Micro Diameter Drill / Chamfering Cutter and Center Drill |                              |   |   |   |   |   |  |  |  |  |  |   |   |   |   |  |   |   |   |     |     |
| <b>PMD STD</b>   | φ0.02 ~ φ0.1                 | ○ | ○ |   |   |   |  |  |  |  |  | ○ | ● |   |   |  | ● | ● |   | 598 |     |
| <b>PMD PLT</b>   | φ0.02 ~ φ0.1                 | ○ | ○ |   |   |   |  |  |  |  |  | ○ | ● |   |   |  | ● | ● |   | 599 |     |
| <b>PSM</b>   | φ1 X half included angle 45° | ○ | ○ |   |   |   |  |  |  |  |  | ○ | ● |   |   |  | ● | ● |   | 599 |     |
| Flat Drill   |                              |   |   |   |   |   |  |  |  |  |  |   |   |   |   |  |   |   |   |     |     |
| <b>UTDF</b>  | φ2 ~ φ12                     | ● | ● | ○ |   |   |  |  |  |  |  | ● | ● |   |   |  |   |   |   | 580 |     |
| Carbide Drill  |                              |   |   |   |   |   |  |  |  |  |  |   |   |   |   |  |   |   |   |     |     |
| <b>UTDSX</b>   | φ0.3 ~ φ2                    | ● | ● | ○ |   |   |  |  |  |  |  | ○ | ● |   |   |  | ○ | ○ |   | 586 |     |
| <b>C-UMD</b>   | φ0.1 ~ φ3                    | ● | ● | ○ |   |   |  |  |  |  |  | ○ | ● |   |   |  | ○ | ○ |   | 588 |     |
| <b>UTDLX</b>   | φ0.3 ~ φ3                    | ● | ● | ○ |   |   |  |  |  |  |  | ○ | ● |   |   |  | ○ | ○ |   | 594 |     |
| UDC Drill / Thread Mill  |                              |   |   |   |   |   |  |  |  |  |  |   |   |   |   |  |   |   |   |     |     |
| <b>UDCMX</b>   | φ0.3 ~ φ7                    |   |   |   |   |   |  |  |  |  |  |   |   |   |   |  | ● |   | ★ | ●   | 110 |
| <b>UDCT</b>  | M2 ~ M8                      |   |   |   |   |   |  |  |  |  |  |   |   |   |   |  | ○ |   | ★ | ●   | 114 |

★ Highly Recommended ● Recommended ○ Suggested













# Series

※ For the different types of square, radius and ball for steels, please refer to "Tool Type".

| Number of Flute | Appearance | Model Number | Coating | Helix Angle | Features |
|-----------------|------------|--------------|---------|-------------|----------|
|-----------------|------------|--------------|---------|-------------|----------|

## V Series / $\phi 3$ Shank x Overall Length 38

### V Series Long Neck Ball

|          |   |               |   |     |  |   |
|----------|---|---------------|---|-----|--|---|
| 2 Flutes |  | <b>VHGLB</b>  |  | 30° | Long neck ball for hard materials<br>Suitable for 60HRC or above such as high-speed steels | Super negative rake angle  |
| 2 Flutes |  | <b>VHSLB</b>  |  | 30° | Long neck ball for hard materials  | Negative rake angle        |
| 2 Flutes |  | <b>VCSELB</b> |  | 30° | Standard shaped long neck ball<br>Prioritizes surface quality                              | Neutral rake angle         |
| 2 Flutes |  | <b>VDCLB</b>  |  | 30° | DLC coated long neck ball<br>Prevents burrs and chattering with positive rake angle        | Positive rake angle        |

### V Series Long Neck Square




|          |   |             |   |     |                                     |   |
|----------|---|-------------|---|-----|-------------------------------------|---|
| 2 Flutes |  | <b>VHLS</b> |  | 30° | Long neck square for hard materials | Negative rake angle  |
|----------|---|-------------|---|-----|-------------------------------------|---|

### V Series Long Neck Radius




|          |   |              |   |     |                                     |   |
|----------|---|--------------|---|-----|-------------------------------------|---|
| 2 Flutes |  | <b>VHLRS</b> |  | 30° | Long neck radius for hard materials | Negative rake angle  |
|----------|---|--------------|---|-----|-------------------------------------|---|

## CBN

### CBN Long Neck Ball







|          |   |                 |   |     |  |  |
|----------|---|-----------------|---|-----|--|--|
| 2 Flutes |  | <b>CBN-PLB</b>  | — | 0°  | For super mirror milling (burnishing effect)<br>2 flute long neck ball |  |
| 2 Flutes |  | <b>CBN-LBSF</b> | — | 20° | Excellent surface quality<br>2 flute long neck ball                    |  |
| 2 Flutes |  | <b>CBN-LBF</b>  | — | 0°  | High rigidity and long tool life<br>2 flute long neck ball             |  |

### CBN Long Neck Radius







|          |   |                     |   |    |  |  |
|----------|---|---------------------|---|----|--|--|
| 1 Flute  |   | <b>CBN-RSF</b>      | — | 0° | Excellent surface finish<br>1 flute long neck radius         |  |
| 2 Flutes |  | <b>CBN-LRF 2000</b> | — | 0° | High rigidity and long tool life<br>2 flute long neck radius |  |
| 4 Flutes |  | <b>CBN-LRF 4000</b> | — | 0° | High rigidity and long tool life<br>4 flute long neck radius |  |

## UDC for Cemented Carbide and Hard Brittle Materials

### UDC Ball

|          |   |              |   |    |                                 |  |
|----------|---|--------------|---|----|---------------------------------|--|
| 2 Flutes |  | <b>UDCBH</b> |  | 0° | High efficiency<br>2 flute ball |  |
| 2 Flutes |  | <b>UDCBF</b> |  | 0° | For finishing<br>2 flute ball   |  |
| 2 Flutes |  | <b>UDCB</b>  |  | 0° | Lower costs<br>2 flute ball     |  |

### UDC Long Neck Ball

|          |   |               |   |    |   |  |
|----------|---|---------------|---|----|---|--|
| 2 Flutes |  | <b>UDCLBH</b> |  | 0° | High efficiency<br>2 flute long neck ball |  |
| 2 Flutes |  | <b>UDCLBF</b> |  | 0° | For finishing<br>2 flute long neck ball   |  |
| 2 Flutes |  | <b>UDCLB</b>  |  | 0° | Lower costs<br>2 flute long neck ball     |  |

| Model Number | Size | Carbon Steels | Alloy Steels<br>SUS | Prehardened Steels | Hardened Steels |          |          |          |          | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials | Page |
|--------------|------|---------------|---------------------|--------------------|-----------------|----------|----------|----------|----------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|------|
|              |      |               |                     |                    | ≤ 50 HRC        | ≤ 55 HRC | ≤ 60 HRC | ≤ 65 HRC | ≤ 70 HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |      |

### V Series / φ3 Shank x Overall Length 38

#### V Series Long Neck Ball

|               |              |   |   |   |   |   |   |   |   |   |   |  |   |  |  |   |   |  |  |    |
|---------------|--------------|---|---|---|---|---|---|---|---|---|---|--|---|--|--|---|---|--|--|----|
| <b>VHGLB</b>  | R0.05 ~ R1.5 |   |   | ○ | ● | ● | ● | ★ | ★ |   |   |  |   |  |  |   |   |  |  | 34 |
| <b>VHSLB</b>  | R0.05 ~ R1.5 | ○ | ○ | ● | ● | ● | ● | ○ |   | ○ |   |  | ○ |  |  | ○ | ○ |  |  | 37 |
| <b>VCSELB</b> | R0.05 ~ R1.5 | ● | ● | ● | ● | ● |   |   |   | ○ | ● |  | ● |  |  | ○ | ○ |  |  | 44 |
| <b>VDCLB</b>  | R0.05 ~ R1   |   |   |   |   |   |   |   |   |   | ● |  | ★ |  |  |   |   |  |  | 48 |

#### V Series Long Neck Square

|             |           |   |   |   |   |   |   |  |  |   |  |  |   |  |  |   |   |  |  |    |
|-------------|-----------|---|---|---|---|---|---|--|--|---|--|--|---|--|--|---|---|--|--|----|
| <b>VHLS</b> | φ0.1 ~ φ2 | ○ | ○ | ● | ● | ● | ○ |  |  | ○ |  |  | ○ |  |  | ○ | ○ |  |  | 52 |
|-------------|-----------|---|---|---|---|---|---|--|--|---|--|--|---|--|--|---|---|--|--|----|

#### V Series Long Neck Radius

|              |           |   |   |   |   |   |   |   |  |   |  |  |   |  |  |   |   |  |  |    |
|--------------|-----------|---|---|---|---|---|---|---|--|---|--|--|---|--|--|---|---|--|--|----|
| <b>VHLRS</b> | φ0.2 ~ φ2 | ○ | ○ | ● | ● | ● | ● | ○ |  | ○ |  |  | ● |  |  | ○ | ○ |  |  | 55 |
|--------------|-----------|---|---|---|---|---|---|---|--|---|--|--|---|--|--|---|---|--|--|----|

### CBN

#### CBN Long Neck Ball

|                 |             |  |  |   |   |   |   |   |   |  |  |  |  |  |  |  |  |  |  |     |
|-----------------|-------------|--|--|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|-----|
| <b>CBN-PLB</b>  | R0.2 ~ R0.5 |  |  | ○ | ● | ● | ● | ● | ● |  |  |  |  |  |  |  |  |  |  | 120 |
| <b>CBN-LBSF</b> | R0.05 ~ R1  |  |  | ○ | ● | ● | ● | ● | ● |  |  |  |  |  |  |  |  |  |  | 122 |
| <b>CBN-LBF</b>  | R0.05 ~ R2  |  |  | ○ | ● | ● | ● | ● | ● |  |  |  |  |  |  |  |  |  |  | 126 |

#### CBN Long Neck Radius

|                     |           |  |  |   |   |   |   |   |   |  |  |  |  |  |  |  |  |  |  |     |
|---------------------|-----------|--|--|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|-----|
| <b>CBN-RSF</b>      | φ0.2 ~ φ2 |  |  |   |   |   | ● | ● |   |  |  |  |  |  |  |  |  |  |  | 132 |
| <b>CBN-LRF 2000</b> | φ0.1 ~ φ3 |  |  | ○ | ● | ● | ● | ● | ● |  |  |  |  |  |  |  |  |  |  | 136 |
| <b>CBN-LRF 4000</b> | φ0.1 ~ φ2 |  |  | ○ | ● | ● | ● | ● | ● |  |  |  |  |  |  |  |  |  |  | 146 |

### UDC for Cemented Carbide and Hard Brittle Materials

#### UDC Ball

|              |           |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |   |    |
|--------------|-----------|--|--|--|--|--|--|--|--|--|--|--|--|--|---|--|--|---|---|----|
| <b>UDCBH</b> | R0.3 ~ R1 |  |  |  |  |  |  |  |  |  |  |  |  |  | ○ |  |  | ★ | ● | 68 |
| <b>UDCBF</b> | R0.1 ~ R3 |  |  |  |  |  |  |  |  |  |  |  |  |  | ○ |  |  | ★ | ● | 70 |
| <b>UDCB</b>  | R0.1 ~ R3 |  |  |  |  |  |  |  |  |  |  |  |  |  | ○ |  |  | ★ | ● | 72 |






















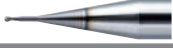














#### UDC Long Neck Ball

|               |           |  |  |  |  |  |  |  |  |  |  |  |  |  |   |  |  |   |   |    |
|---------------|-----------|--|--|--|--|--|--|--|--|--|--|--|--|--|---|--|--|---|---|----|
| <b>UDCLBH</b> | R0.3 ~ R1 |  |  |  |  |  |  |  |  |  |  |  |  |  | ○ |  |  | ★ | ● | 76 |
| <b>UDCLBF</b> | R0.1 ~ R3 |  |  |  |  |  |  |  |  |  |  |  |  |  | ○ |  |  | ★ | ● | 80 |
| <b>UDCLB</b>  | R0.1 ~ R3 |  |  |  |  |  |  |  |  |  |  |  |  |  | ○ |  |  | ★ | ● | 84 |

★ Highly Recommended ● Recommended ○ Suggested

# Series

※ For the different types of square, radius and ball for steels, please refer to "Tool Type".

| Number of Flute  | Appearance  | Model Number       | Coating   | Helix Angle  | Features   |  |
|--|---|--------------------|---|--------------|--|--|
| <b>UDC Long Neck Radius</b>  |   |                    |   |              |  |  |
| 2 Flutes   |    | <b>UDCLRSF</b>     |    | 0°           | For finishing<br>2 flute long neck radius  |  |
| 2 Flutes   |    | <b>UDCLRS</b>      |    | 0°           | Lower costs<br>2 flute long neck radius  |  |
| 6-10 Flutes  |    | <b>UDCRRS</b>      |    | 40°          | 6-10 flute highly efficient long neck radius for roughing  |  |
| <b>UDC Drill</b>   |   |                    |   |              |  |  |
| 2 Flutes   |    | <b>UDCMX</b>       |    | 30°          | Drills for Cemented Carbide and Hard Brittle Materials   |  |
| <b>UDC for Threading</b>   |   |                    |   |              |  |  |
| 2 Flutes   |    | <b>UDCT</b>        |    | —            | Thread mills for Cemented Carbide and Hard Brittle Materials   |  |
| <b>PCD for Finishing Cemented Carbide and Hard Brittle Materials</b> |   |                    |   |              |  |  |
| 1 Flute  |    | <b>UPDLRS</b>      | —   | 0°           | 1 flute long neck radius with binderless PCD<br>After milling with UDC, improve mirror surface finish by using UPD |  |
| 1 Flute  |    | <b>UPDLB</b>       | —   | 0°           | 1 flute long neck ball with binderless PCD<br>After milling with UDC, improve mirror surface finish by using UPD   |  |
| <b>For Copper Electrode Milling</b>                                  |   |                    |   |              |  |  |
| 2 Flutes   |    | <b>CRN-ES 2000</b> |    | 20°          | CrN COAT 2 flute square  | Positive rake angle   |
| 4 Flutes   |    | <b>CRN-ES 4000</b> |    | 25°          | CrN COAT 4 flute square  | Positive rake angle   |
| 2 Flutes   |    | <b>VDLCLB</b>      |    | 30°          | V series φ3 shank x overall length 38<br>DLC coating 2 flute long neck ball  | Positive rake angle   |
| 2 Flutes   |   | <b>DLCLB</b>       |   | 30°          | DLC coating 2 flute long neck ball   | Positive rake angle  |
| <b>For Stainless Steel Milling</b>                                   |   |                    |   |              |  |  |
| 4 Flutes   |  | <b>CESUS</b>       |  | 40°<br>~ 42° | Special design for SUS milling<br>4 flute highly efficient square with variable pitch and helix design             |  |
| <b>For Aluminum Milling</b>  |   |                    |   |              |  |  |
| 2 Flutes   |  | <b>CAS</b>         | —   | 45°          | NON-COAT 2 flute square  |  |
| 3 Flutes   |  | <b>AZS</b>         | —   | 45°          | NON-COAT 3 flute highly efficient long neck square that enables vertical milling                                   |  |
| 3 Flutes   |  | <b>DLC-AZS</b>     |  | 45°          | AZS with DLC coating<br>DLC coating 3 flute long neck square   |  |
| 3 Flutes   |  | <b>DLC-CFB</b>     |  | 30°          | DLC coating 3 flute ball   |  |
| <b>NON-COAT for Plastic Milling</b>                                  |   |                    |   |              |  |  |
| 2 Flutes   |  | <b>CPS</b>         | —   | 30°          | NON-COAT 2 flute square  |  |
| 2 Flutes   |  | <b>CPR</b>         | —   | 30°          | NON-COAT 2 flute long neck square  |  |
| 2 Flutes   |  | <b>CPRL</b>        | —   | 30°          | CPR with long shank<br>NON-COAT 2 flute Long neck & long shank   |  |
| 2 Flutes   |  | <b>CPRB</b>        | —   | 30°          | NON-COAT 2 flute long neck ball  |  |

| Model Number | Size | Carbon Steels | Alloy Steels<br>SUS | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials | Page |
|--------------|------|---------------|---------------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|------|
|              |      |               |                     |                    | 50 HRC          | 55 HRC | 60 HRC | 65 HRC | 70 HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |      |

|  |            |   |   |   |  |  |  |  |  |   |  |   |   |   |   |   |   |   |     |
|--|------------|---|---|---|--|--|--|--|--|---|--|---|---|---|---|---|---|---|-----|
| <b>UDC Long Neck Radius</b>  |            |   |   |   |  |  |  |  |  |   |  |   |   |   |   |   |   |   |     |
| <b>UDCLRSF</b>   | φ0.25 ~ φ2 |   |   |   |  |  |  |  |  |   |  |   |   | ○ |   |   | ★ | ● | 90  |
| <b>UDCLRS</b>  | φ0.3 ~ φ2  |   |   |   |  |  |  |  |  |   |  |   |   | ○ |   |   | ★ | ● | 98  |
| <b>UDCRRS</b>  | φ2 ~ φ6    |   |   |   |  |  |  |  |  |   |  |   |   | ○ |   |   | ★ | ● | 104 |
| <b>UDC Drill</b>   |            |   |   |   |  |  |  |  |  |   |  |   |   |   |   |   |   |   |     |
| <b>UDCMX</b>   | φ0.3 ~ φ7  |   |   |   |  |  |  |  |  |   |  |   |   | ● |   |   | ★ | ● | 110 |
| <b>UDC for Threading</b>   |            |   |   |   |  |  |  |  |  |   |  |   |   |   |   |   |   |   |     |
| <b>UDCT</b>  | M2 ~ M8    |   |   |   |  |  |  |  |  |   |  |   |   | ○ |   |   | ★ | ● | 114 |
| <b>PCD for Finishing Cemented Carbide and Hard Brittle Materials</b> |            |   |   |   |  |  |  |  |  |   |  |   |   |   |   |   |   |   |     |
| <b>UPDLRS</b>  | φ0.2 ~ φ2  |   |   |   |  |  |  |  |  |   |  |   |   |   |   |   | ★ | ● | 108 |
| <b>UPDLB</b>   | R0.1 ~ R1  |   |   |   |  |  |  |  |  |   |  |   |   |   |   |   | ★ | ● | 88  |
| <b>For Copper Electrode Milling</b>                                  |            |   |   |   |  |  |  |  |  |   |  |   |   |   |   |   |   |   |     |
| <b>CRN-ES 2000</b>   | φ0.2 ~ φ12 |   |   |   |  |  |  |  |  | ○ |  | ★ | ○ |   |   |   |   |   | 186 |
| <b>CRN-ES 4000</b>   | φ3 ~ φ12   |   |   |   |  |  |  |  |  | ○ |  | ★ | ○ |   |   |   |   |   | 232 |
| <b>VDLCLB</b>  | R0.05 ~ R1 |   |   |   |  |  |  |  |  | ● |  | ★ |   |   |   |   |   |   | 48  |
| <b>DLCLB</b>   | R0.05 ~ R3 |   |   |   |  |  |  |  |  | ● |  | ★ |   |   |   |   |   |   | 516 |
| <b>For Stainless Steel Milling</b>                                   |            |   |   |   |  |  |  |  |  |   |  |   |   |   |   |   |   |   |     |
| <b>CESUS</b>   | φ6 ~ φ12   | ● | ★ | ○ |  |  |  |  |  | ○ |  | ○ |   |   | ○ | ○ |   |   | 228 |
| <b>For Aluminum Milling</b>  |            |   |   |   |  |  |  |  |  |   |  |   |   |   |   |   |   |   |     |
| <b>CAS</b>   | φ0.5 ~ φ12 |   |   |   |  |  |  |  |  | ★ |  | ○ |   |   |   |   |   |   | 192 |
| <b>AZS</b>   | φ1 ~ φ12   |   |   |   |  |  |  |  |  | ★ |  | ○ | ○ |   |   |   |   |   | 278 |
| <b>DLC-AZS</b>   | φ1 ~ φ12   |   |   |   |  |  |  |  |  | ★ |  | ○ | ○ |   |   |   |   |   | 282 |
| <b>DLC-CFB</b>   | R0.3 ~ R6  |   |   |   |  |  |  |  |  | ★ |  | ○ | ○ |   |   |   |   |   | 448 |
| <b>NON-COAT for Plastic Milling</b>                                  |            |   |   |   |  |  |  |  |  |   |  |   |   |   |   |   |   |   |     |
| <b>CPS</b>   | φ0.3 ~ φ12 |   |   |   |  |  |  |  |  | ○ |  | ● | ★ |   |   |   |   |   | 190 |
| <b>CPR</b>   | φ0.5 ~ φ6  |   |   |   |  |  |  |  |  | ○ |  | ● | ★ |   |   |   |   |   | 270 |
| <b>CPRL</b>  | φ0.5 ~ φ4  |   |   |   |  |  |  |  |  | ○ |  | ● | ★ |   |   |   |   |   | 274 |
| <b>CPRB</b>  | R0.2 ~ R3  |   |   |   |  |  |  |  |  | ○ |  | ● | ★ |   |   |   |   |   | 526 |















★ Highly Recommended ● Recommended ○ Suggested

# Series




※ For the different types of square, radius and ball for steels, please refer to "Tool Type".

| Number of Flute | Appearance | Model Number | Coating | Helix Angle | Features |
|-----------------|------------|--------------|---------|-------------|----------|
|-----------------|------------|--------------|---------|-------------|----------|


## DIA COAT for Graphite Milling

|          |   |                  |   |     |                                   |
|----------|---|------------------|---|-----|-----------------------------------|
| 2 Flutes |  | <b>DCEs 2000</b> |  | 30° | DIA COAT 2 flute square           |
| 4 Flutes |  | <b>DCEs 4000</b> |  | 30° | DIA COAT 4 flute square           |
| 2 Flutes |  | <b>DCLS</b>      |  | 30° | DIA COAT 2 flute long neck square |
| 4 Flutes |  | <b>DCLRS</b>     |  | 30° | DIA COAT 4 flute long neck radius |
| 2 Flutes |  | <b>DCB</b>       |  | 35° | DIA COAT 2 flute ball             |
| 2 Flutes |  | <b>DCLB</b>      |  | 35° | DIA COAT 2 flute long neck ball   |
| 2 Flutes |  | <b>DCTNB</b>     |  | 35° | DIA COAT 2 flute taper neck ball  |


## NON-COAT for Graphite Milling

|          |   |                 |   |     |                         |
|----------|---|-----------------|---|-----|-------------------------|
| 4 Flutes |  | <b>CGE</b>      | — | 45° | NON-COAT 4 flute square |
| 2 Flutes |  | <b>CGB 2000</b> | — | 35° | NON-COAT 2 flute ball   |
| 4 Flutes |  | <b>CGB 4000</b> | — | 35° | NON-COAT 4 flute ball   |

## Barrel Form




|          |   |             |   |   |  |
|----------|---|-------------|---|---|--|
| 4 Flutes |    | <b>COVB</b> |    | — | Oval barrel form<br>Suitable for narrow area with small inclined angle                     |
| 4 Flutes |   | <b>CSTB</b> |   | — | Standard taper barrel form<br>Suitable for highly efficient finishing with larger barrel R |
| 4 Flutes |  | <b>CWTB</b> |  | — | Wide taper barrel form<br>Suitable for finishing with wide taper angle                     |

## NON-COAT for Chamfering

|          |   |           |   |     |   |
|----------|---|-----------|---|-----|---|
| 2 Flutes |  | <b>SV</b> | — | 30° | NON-COAT and half included angle 45°<br>Peripheral spiral shape designed for reducing burrs |
|----------|---|-----------|---|-----|---|

## Drill







Over All Length 38.1 x Shank Diameter 3.175 mm  
P Series Micro Diameter Drill / Chamfering Cutter and Center Drill

|          |   |                |   |    |  |                     |
|----------|---|----------------|---|----|--|---------------------|
| 2 Flutes |  | <b>PMD STD</b> | — | —  | NON-COAT micro diameter drill<br>Flute length L/D=10 times                   | 4-facet drill point |
| 2 Flutes |  | <b>PMD PLT</b> | — | —  | NON-COAT micro diameter drill for pilot drilling<br>Flute length L/D=2 times | 4-facet drill point |
| 1 Flute  |  | <b>PSM</b>     | — | 0° | NON-COAT for chamfering, counter sink, and center drill<br>Taper angle 90°   | —                   |

## Flat Drill

|          |   |             |   |     |   |                  |
|----------|---|-------------|---|-----|---|------------------|
| 2 Flutes |  | <b>UTDF</b> |  | 30° | Size M4 - M12 for drilling pilot holes before tapping | Point angle 180° |
|----------|---|-------------|---|-----|---|------------------|

## Carbide Drill

|          |   |              |   |     |   |                                |
|----------|---|--------------|---|-----|---|--------------------------------|
| 2 Flutes |  | <b>UTDSX</b> |  | 30° | Short slot length L/D=5 times<br>Diameter tolerance 0/-0.01 | Point angle 130°<br>X thinning |
| 2 Flutes |  | <b>C-UMD</b> |  | 24° | Medium slot length<br>Diameter tolerance 0/-0.01            | Point angle 150°               |
| 2 Flutes |  | <b>UTDLX</b> |  | 30° | Long slot length L/D=15 times<br>Diameter tolerance 0/-0.01 | Point angle 130°<br>X thinning |



| Model Number | Size | Carbon Steels | Alloy Steels<br>SUS | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Heat Resistant Materials (Non-Metallic) | Page |
|--------------|------|---------------|---------------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---|------|
|              |      |               |                     |                    | 50 HRC          | 55 HRC | 60 HRC | 65 HRC | 70 HRC |           |                 |          |        |          |                       |                 |                       |                  |   |      |

### DIA COAT for Graphite Milling

|                  |           |  |  |  |  |  |  |  |  |  |   |   |   |   |   |  |  |  |   |     |
|------------------|-----------|--|--|--|--|--|--|--|--|--|---|---|---|---|---|--|--|--|---|-----|
| <b>DCES 2000</b> | φ0.2 ~ φ6 |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ● |  |  |  | ○ | 188 |
| <b>DCES 4000</b> | φ3 ~ φ10  |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ● |  |  |  | ○ | 234 |
| <b>DCLS</b>      | φ0.4 ~ φ6 |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ● |  |  |  | ○ | 266 |
| <b>DCLRS</b>     | φ1 ~ φ6   |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ● |  |  |  | ○ | 396 |
| <b>DCB</b>       | R0.5 ~ R6 |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ● |  |  |  | ○ | 438 |
| <b>DCLB</b>      | R0.2 ~ R3 |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ● |  |  |  | ○ | 512 |
| <b>DCTNB</b>     | R0.5 ~ R1 |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ● |  |  |  | ○ | 556 |

### NON-COAT for Graphite Milling

|                 |           |  |  |  |  |  |  |  |  |  |   |   |   |   |   |  |  |  |  |     |
|-----------------|-----------|--|--|--|--|--|--|--|--|--|---|---|---|---|---|--|--|--|--|-----|
| <b>CGE</b>      | φ2 ~ φ20  |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ○ |  |  |  |  | 236 |
| <b>CGB 2000</b> | R0.2 ~ R6 |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ○ |  |  |  |  | 440 |
| <b>CGB 4000</b> | R2 ~ R10  |  |  |  |  |  |  |  |  |  | ○ | ★ | ○ | ○ | ○ |  |  |  |  | 458 |

### Barrel Form

|             |               |   |   |   |   |   |  |  |  |  |   |   |  |   |  |  |   |   |  |     |
|-------------|---------------|---|---|---|---|---|--|--|--|--|---|---|--|---|--|--|---|---|--|-----|
| <b>COVB</b> | Tip R1 and R2 | ● | ● | ● | ● | ● |  |  |  |  | ○ | ● |  | ● |  |  | ○ | ○ |  | 572 |
| <b>CSTB</b> | Tip R1 ~ R3   | ● | ● | ● | ● | ● |  |  |  |  | ○ | ● |  | ● |  |  | ○ | ○ |  | 574 |
| <b>CWTB</b> | Tip R1        | ● | ● | ● | ● | ● |  |  |  |  | ○ | ● |  | ● |  |  | ○ | ○ |  | 576 |

### NON-COAT for Chamfering

|           |          |   |   |   |  |  |  |  |  |  |   |   |   |   |   |  |  |  |  |     |
|-----------|----------|---|---|---|--|--|--|--|--|--|---|---|---|---|---|--|--|--|--|-----|
| <b>SV</b> | φ3 ~ φ12 | ● | ● | ● |  |  |  |  |  |  | ○ | ○ | ○ | ○ | ○ |  |  |  |  | 578 |
|-----------|----------|---|---|---|--|--|--|--|--|--|---|---|---|---|---|--|--|--|--|-----|

### Drill

Over All Length 38.1 x Shank Diameter 3.175 mm  
P Series Micro Diameter Drill / Chamfering Cutter and Center Drill

|                |                              |   |   |  |  |  |  |  |  |  |   |   |  |   |   |  |  |  |  |     |
|----------------|------------------------------|---|---|--|--|--|--|--|--|--|---|---|--|---|---|--|--|--|--|-----|
| <b>PMD STD</b> | φ0.02 ~ φ0.1                 | ○ | ○ |  |  |  |  |  |  |  | ○ | ● |  | ● | ● |  |  |  |  | 598 |
| <b>PMD PLT</b> | φ0.02 ~ φ0.1                 | ○ | ○ |  |  |  |  |  |  |  | ○ | ● |  | ● | ● |  |  |  |  | 599 |
| <b>PSM</b>     | φ1 x half included angle 45° | ○ | ○ |  |  |  |  |  |  |  | ○ | ● |  | ● | ● |  |  |  |  | 599 |

### Flat Drill

|             |          |   |   |   |  |  |  |  |  |  |   |   |  |  |  |  |  |  |  |     |
|-------------|----------|---|---|---|--|--|--|--|--|--|---|---|--|--|--|--|--|--|--|-----|
| <b>UTDF</b> | φ2 ~ φ12 | ● | ● | ○ |  |  |  |  |  |  | ● | ● |  |  |  |  |  |  |  | 580 |
|-------------|----------|---|---|---|--|--|--|--|--|--|---|---|--|--|--|--|--|--|--|-----|

### Carbide Drill

|              |           |   |   |   |  |  |  |  |  |  |   |   |  |   |  |  |   |   |  |     |
|--------------|-----------|---|---|---|--|--|--|--|--|--|---|---|--|---|--|--|---|---|--|-----|
| <b>UTDSX</b> | φ0.3 ~ φ2 | ● | ● | ○ |  |  |  |  |  |  | ○ | ● |  | ○ |  |  | ○ | ○ |  | 586 |
| <b>C-UMD</b> | φ0.1 ~ φ3 | ● | ● | ○ |  |  |  |  |  |  | ○ | ● |  | ○ |  |  | ○ | ○ |  | 588 |
| <b>UTDLX</b> | φ0.3 ~ φ3 | ● | ● | ○ |  |  |  |  |  |  | ○ | ● |  | ○ |  |  | ○ | ○ |  | 594 |

★ Highly Recommended ● Recommended ○ Suggested



# *Value Series*

*ϕ3mm Shank End Mills*



Recommended for improved milling quality and cost reduction!

# New $\phi 3$ mm shank

Union Tool's new standard: Value series

## $\phi 3$ mm Shank (h4 tolerance) × Overall length 38 mm

Fixed size of  $\phi 3$  Shank × Overall Length 38 mm

$\phi 3$  shank is used to save valuable carbide material. h4 tolerance is compatible for both shrink fit and collet holders. More series to follow in the future.

## Cost effective

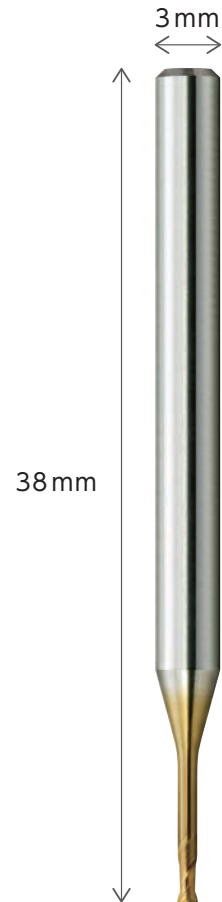
PCB drills mass production technology is applied to end mills.

To attain affordable prices, we applied our existing and proven automatic mass production technology for blank rods, flute grinding, coating and inspection to these new end mills.

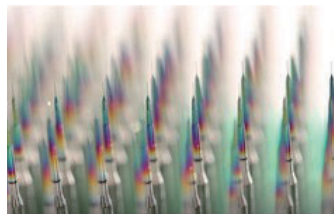
## High Quality

Small diameter V series are high-precision as a result of using the latest in-house technologies.

We developed new grinding machines specialized for small diameter end mills for high-precision milling that will innovate manufacturing technology for high-precision, high-efficiency milling.



Our in-house developed production facility for PCB tools



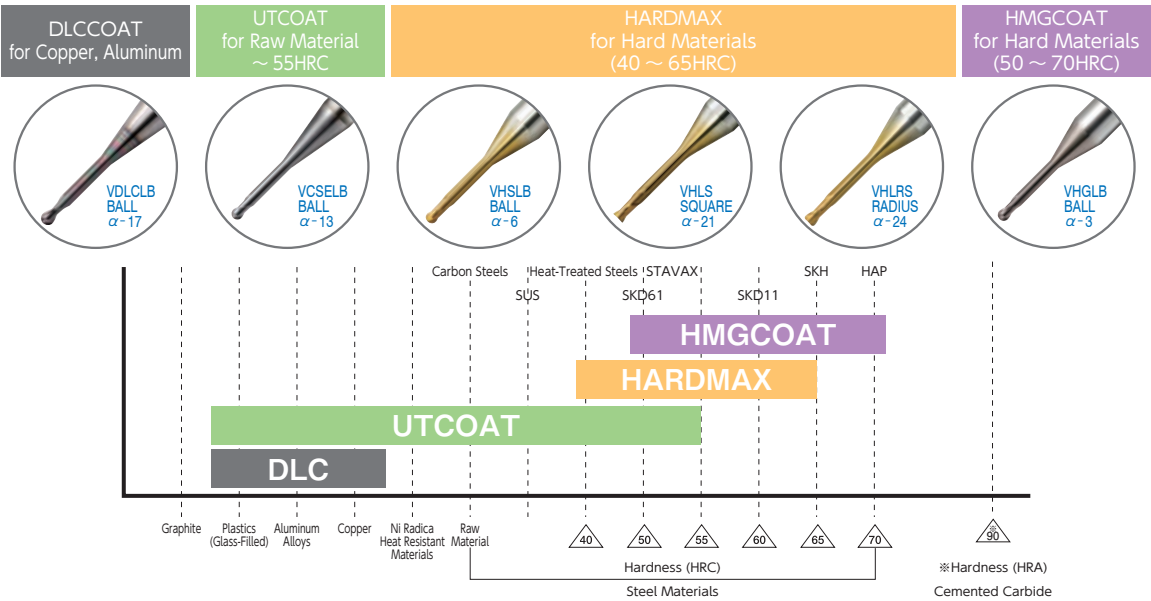
Over 5 million coated PCB tools manufactured every month



Carefully crafted in Mitsuke of Niigata prefecture

PCB: Printed Circuit Board

# Find the best coating for your material applications



## Long Neck Ball End Mills R0.5 x Effective Length 6

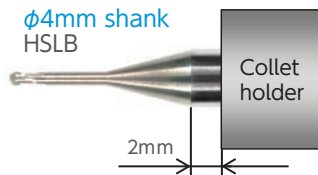
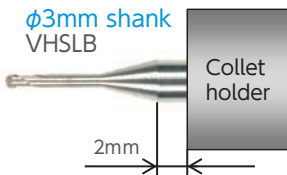
Milling examples of shank diameter difference between  $\phi 3$  mm &  $\phi 4$  mm

### Comparison of tool wearing and Dimensional accuracy

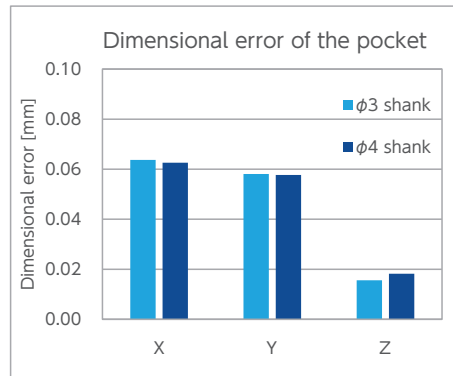
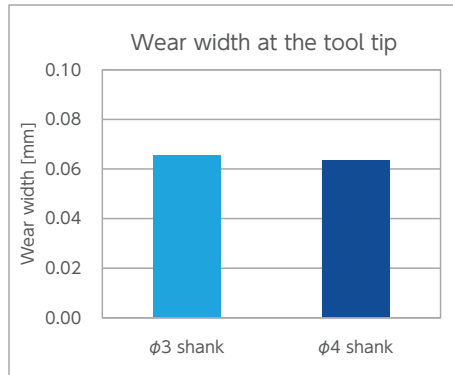
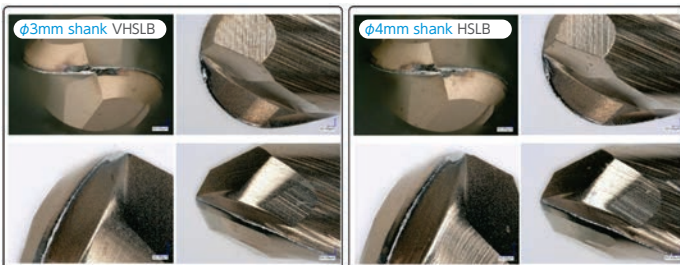
<Condition>

Work material : SKD11(60HRC) (DIN : 1.2379, AISI : D2)  
 Coolant : Air blow  
 Tool holder : Collet holder  
 Milling shape : Pocket (□8mm x 8mm x depth 3mm)  
 Cycle time : about 35 min.

$n$  : 21,500 min<sup>-1</sup>  
 $V_f$  : 1,250 mm/min  
 $a_p$  : 0.03 mm  
 $a_e$  : 0.17 mm



<Tool damage>



If the overhang is shortened, the performance equivalent to that of a  $\phi 4$ mm shank can be obtained.

# VHGLB

Value Series HMGCOAT Longneck Ball

## HMGCOAT 2 Flutes Short Shank Long Neck Ball End Mills

NEW

Super  
MG

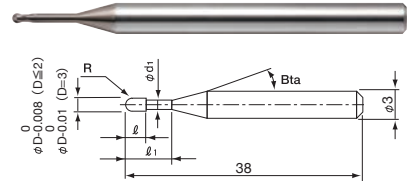
HMG  
COAT

Shank Dia  
0/-0.003



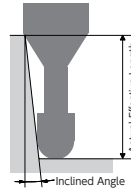
Back Taper  
Geometry

Except for R0.05~R0.4



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy |
|---------------------|--------------------|----------------------|
| R0.05 ~ R0.075      | 0/-0.008           | ± 0.002              |
| R0.1 ~ R1           |                    | ± 0.003              |
| R1.5                | 0/-0.01            |                      |



### Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| CARBON STEELS<br>S45C<br>S55C | ALLOY STEELS<br>SK / SCM<br>SUS | PREHARDENED<br>STEELS<br>NAK<br>HPM | HARDENED STEELS |        |        |        |        | CAST IRON | ALUMINUM<br>ALLOYS | GRAPHITE | COPPER | PLASTICS | GLASS<br>FILLED<br>PLASTICS | TITANIUM<br>ALLOYS | HEAT<br>RESISTANT<br>ALLOYS | CEMENTED<br>CARBIDE | HARD BRITTLE<br>(NON-METALLIC)<br>MATERIALS |
|-------------------------------|---------------------------------|-------------------------------------|-----------------|--------|--------|--------|--------|-----------|--------------------|----------|--------|----------|-----------------------------|--------------------|-----------------------------|---------------------|---|
|                               |                                 |                                     | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                    |          |        |          |                             |                    |                             |                     |   |
|                               |                                 | ○                                   | ●               | ●      | ●      | ★      | ★      |           |                    |          |        |          |                             |                    |                             |                     |   |

### Total 31 models

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l_2$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Effective Length by Inclined Angles |                 |                 |                 |                 | Suggested Retail Price ¥ |
|-----------------|-----------------------|------------------------|---------------------|--------------------------|-----------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|--------------------------|
|                 |                       |                        |                     |                          |                       | 30°                                 | 1°              | 1° 30'          | 2°              | 3°              |                          |
| VHGLB 2001-003  | R0.05                 | 0.3                    | 0.08                | 0.093                    | 16°                   | 0.34                                | 0.36            | 0.38            | 0.40            | 0.44            | 6,180                    |
| VHGLB 20015-003 | R0.075                | 0.3                    | 0.12                | 0.14                     | 16°                   | 0.36                                | 0.38            | 0.40            | 0.41            | 0.45            | 7,200                    |
| VHGLB 2002-005  | R0.1                  | 0.5                    | 0.16                | 0.18                     | 16°                   | 0.63                                | 0.66            | 0.68            | 0.71            | 0.76            | 4,320                    |
| VHGLB 2002-010  | R0.1                  | 1                      | 0.16                | 0.18                     | 16°                   | 1.15                                | 1.20            | 1.24            | 1.28            | 1.37            | 4,320                    |
| VHGLB 2003-010  | R0.15                 | 1                      | 0.24                | 0.28                     | 16°                   | 1.15                                | 1.19            | 1.23            | 1.27            | 1.36            | 4,260                    |
| VHGLB 2003-015  | R0.15                 | 1.5                    | 0.24                | 0.28                     | 16°                   | 1.67                                | 1.73            | 1.78            | 1.84            | 1.97            | 4,560                    |
| VHGLB 2004-010  | R0.2                  | 1                      | 0.32                | 0.38                     | 16°                   | 1.15                                | 1.19            | 1.23            | 1.27            | 1.35            | 2,940                    |
| VHGLB 2004-020  | R0.2                  | 2                      | 0.32                | 0.38                     | 16°                   | 2.19                                | 2.25            | 2.33            | 2.40            | 2.57            | 3,060                    |
| VHGLB 2004-030  | R0.2                  | 3                      | 0.32                | 0.38                     | 16°                   | 3.22                                | 3.32            | 3.43            | 3.54            | 3.79            | 3,360                    |
| VHGLB 2005-015  | R0.25                 | 1.5                    | 0.4                 | 0.48                     | 16°                   | 1.67                                | 1.72            | 1.77            | 1.83            | 1.95            | 2,940                    |
| VHGLB 2005-020  | R0.25                 | 2                      | 0.4                 | 0.48                     | 16°                   | 2.19                                | 2.25            | 2.32            | 2.40            | 2.56            | 2,940                    |
| VHGLB 2005-025  | R0.25                 | 2.5                    | 0.4                 | 0.48                     | 16°                   | 2.71                                | 2.79            | 2.87            | 2.97            | 3.18            | 2,940                    |
| VHGLB 2006-010  | R0.3                  | 1                      | 0.48                | 0.58                     | 16°                   | 1.15                                | 1.19            | 1.22            | 1.26            | 1.33            | 2,520                    |
| VHGLB 2006-015  | R0.3                  | 1.5                    | 0.48                | 0.58                     | 16°                   | 1.67                                | 1.72            | 1.77            | 1.82            | 1.94            | 2,280                    |
| VHGLB 2006-020  | R0.3                  | 2                      | 0.48                | 0.58                     | 16°                   | 2.19                                | 2.25            | 2.32            | 2.39            | 2.55            | 2,280                    |
| VHGLB 2006-030  | R0.3                  | 3                      | 0.48                | 0.58                     | 16°                   | 3.22                                | 3.32            | 3.42            | 3.53            | 3.78            | 2,340                    |
| VHGLB 2006-040  | R0.3                  | 4                      | 0.48                | 0.58                     | 16°                   | 4.25                                | 4.38            | 4.52            | 4.67            | 5.00            | 2,400                    |
| VHGLB 2008-020  | R0.4                  | 2                      | 0.64                | 0.78                     | 16°                   | 2.18                                | 2.25            | 2.31            | 2.38            | 2.53            | 2,280                    |
| VHGLB 2008-040  | R0.4                  | 4                      | 0.64                | 0.78                     | 16°                   | 4.25                                | 4.37            | 4.51            | 4.66            | 4.98            | 2,400                    |
| VHGLB 2010-020  | R0.5                  | 2                      | 0.8                 | 0.97                     | 16°                   | 2.20                                | 2.26            | 2.32            | 2.38            | 2.53            | 2,000                    |
| VHGLB 2010-025  | R0.5                  | 2.5                    | 0.8                 | 0.97                     | 16°                   | 2.72                                | 2.79            | 2.87            | 2.95            | 3.14            | 2,000                    |
| VHGLB 2010-030  | R0.5                  | 3                      | 0.8                 | 0.97                     | 16°                   | 3.23                                | 3.32            | 3.42            | 3.52            | 3.75            | 2,000                    |
| VHGLB 2010-040  | R0.5                  | 4                      | 0.8                 | 0.97                     | 16°                   | 4.26                                | 4.39            | 4.52            | 4.66            | 4.98            | 2,160                    |
| VHGLB 2010-060  | R0.5                  | 6                      | 0.8                 | 0.97                     | 16°                   | 6.33                                | 6.52            | 6.72            | 6.94            | 7.43            | 2,340                    |
| VHGLB 2015-030  | R0.75                 | 3                      | 1.2                 | 1.46                     | 16°                   | 3.11                                | 3.19            | 3.28            | 3.37            | 3.57            | 2,220                    |
| VHGLB 2015-040  | R0.75                 | 4                      | 1.2                 | 1.46                     | 16°                   | 4.15                                | 4.26            | 4.38            | 4.51            | 4.79            | 2,220                    |
| VHGLB 2015-060  | R0.75                 | 6                      | 1.2                 | 1.46                     | 16°                   | 6.21                                | 6.39            | 6.58            | 6.78            | 7.24            | 2,220                    |
| VHGLB 2020-030  | R1                    | 3                      | 1.6                 | 1.96                     | 16°                   | 3.11                                | 3.18            | 3.25            | 3.33            | 3.52            | 2,000                    |
| VHGLB 2020-040  | R1                    | 4                      | 1.6                 | 1.96                     | 16°                   | 4.14                                | 4.24            | 4.35            | 4.47            | 4.74            | 2,000                    |
| VHGLB 2020-060  | R1                    | 6                      | 1.6                 | 1.96                     | 16°                   | 6.20                                | 6.37            | 6.55            | 6.75            | 7.19            | 2,160                    |
| VHGLB 2030-060  | R1.5                  | 6                      | 2.4                 | 2.93                     | -                     | No Interference                     | No Interference | No Interference | No Interference | No Interference | 2,340                    |

# VHGLB Milling Conditions

| WORK MATERIAL |                          |                       | PREHARDENED STEELS / HARDENED STEELS<br>NAK / STAVAX<br>(~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                               | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001-003      | R0.05                    | 0.3                   | 48,000   | 200                | 0.005                           | 0.01                             | 48,000                                 | 200                | 0.005                           | 0.01                             | 48,000                                 | 150                | 0.003                           | 0.006                            |
| 20015-003     | R0.075                   | 0.3                   | 48,000   | 230                | 0.007                           | 0.014                            | 48,000                                 | 230                | 0.007                           | 0.014                            | 48,000                                 | 170                | 0.005                           | 0.01                             |
| 2002-005      | R0.1                     | 0.5                   | 44,000   | 250                | 0.01                            | 0.03                             | 42,000                                 | 250                | 0.01                            | 0.03                             | 40,000                                 | 200                | 0.008                           | 0.024                            |
| 2002-010      | R0.1                     | 1                     | 44,000   | 250                | 0.01                            | 0.03                             | 42,000                                 | 250                | 0.01                            | 0.03                             | 40,000                                 | 200                | 0.008                           | 0.024                            |
| 2003-010      | R0.15                    | 1                     | 44,000   | 400                | 0.01                            | 0.03                             | 42,000                                 | 350                | 0.01                            | 0.03                             | 40,000                                 | 300                | 0.01                            | 0.03                             |
| 2003-015      | R0.15                    | 1.5                   | 44,000   | 400                | 0.01                            | 0.03                             | 42,000                                 | 350                | 0.01                            | 0.03                             | 40,000                                 | 300                | 0.01                            | 0.03                             |
| 2004-010      | R0.2                     | 1                     | 44,000   | 600                | 0.015                           | 0.045                            | 42,000                                 | 550                | 0.015                           | 0.045                            | 40,000                                 | 500                | 0.013                           | 0.036                            |
| 2004-020      | R0.2                     | 2                     | 44,000   | 600                | 0.015                           | 0.045                            | 42,000                                 | 550                | 0.015                           | 0.045                            | 40,000                                 | 500                | 0.013                           | 0.036                            |
| 2004-030      | R0.2                     | 3                     | 35,200   | 330                | 0.008                           | 0.024                            | 33,600                                 | 310                | 0.008                           | 0.024                            | 32,000                                 | 280                | 0.008                           | 0.022                            |
| 2005-015      | R0.25                    | 1.5                   | 44,000   | 900                | 0.02                            | 0.065                            | 40,000                                 | 800                | 0.015                           | 0.05                             | 36,000                                 | 600                | 0.015                           | 0.05                             |
| 2005-020      | R0.25                    | 2                     | 44,000   | 900                | 0.02                            | 0.065                            | 40,000                                 | 800                | 0.015                           | 0.05                             | 36,000                                 | 600                | 0.015                           | 0.05                             |
| 2005-025      | R0.25                    | 2.5                   | 44,000   | 900                | 0.02                            | 0.065                            | 40,000                                 | 800                | 0.015                           | 0.05                             | 36,000                                 | 600                | 0.015                           | 0.05                             |
| 2006-010      | R0.3                     | 1                     | 40,000   | 1,400              | 0.045                           | 0.15                             | 36,000                                 | 1,500              | 0.03                            | 0.13                             | 32,000                                 | 1,000              | 0.02                            | 0.1                              |
| 2006-015      | R0.3                     | 1.5                   | 40,000   | 1,400              | 0.03                            | 0.13                             | 36,000                                 | 1,300              | 0.03                            | 0.13                             | 32,000                                 | 1,000              | 0.02                            | 0.1                              |
| 2006-020      | R0.3                     | 2                     | 40,000   | 1,400              | 0.03                            | 0.13                             | 36,000                                 | 1,300              | 0.03                            | 0.13                             | 32,000                                 | 1,000              | 0.02                            | 0.1                              |
| 2006-030      | R0.3                     | 3                     | 40,000   | 1,200              | 0.025                           | 0.1                              | 36,000                                 | 1,100              | 0.025                           | 0.1                              | 32,000                                 | 900                | 0.02                            | 0.1                              |
| 2006-040      | R0.3                     | 4                     | 40,000   | 1,000              | 0.02                            | 0.08                             | 32,000                                 | 800                | 0.02                            | 0.08                             | 32,000                                 | 700                | 0.015                           | 0.07                             |
| 2008-020      | R0.4                     | 2                     | 35,000   | 1,600              | 0.06                            | 0.21                             | 30,000                                 | 1,600              | 0.04                            | 0.17                             | 26,000                                 | 1,350              | 0.04                            | 0.15                             |
| 2008-040      | R0.4                     | 4                     | 35,000   | 1,600              | 0.06                            | 0.21                             | 30,000                                 | 1,600              | 0.04                            | 0.17                             | 26,000                                 | 1,350              | 0.04                            | 0.15                             |
| 2010-020      | R0.5                     | 2                     | 30,000   | 1,750              | 0.2                             | 0.4                              | 24,000                                 | 2,000              | 0.1                             | 0.3                              | 21,000                                 | 1,750              | 0.05                            | 0.2                              |
| 2010-025      | R0.5                     | 2.5                   | 30,000   | 1,750              | 0.2                             | 0.4                              | 24,000                                 | 2,000              | 0.1                             | 0.3                              | 21,000                                 | 1,750              | 0.05                            | 0.2                              |
| 2010-030      | R0.5                     | 3                     | 30,000   | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.1                             | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             |
| 2010-040      | R0.5                     | 4                     | 30,000   | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.1                             | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             |
| 2010-060      | R0.5                     | 6                     | 30,000   | 1,150              | 0.06                            | 0.23                             | 21,500                                 | 1,250              | 0.03                            | 0.17                             | 19,700                                 | 1,050              | 0.025                           | 0.15                             |
| 2015-030      | R0.75                    | 3                     | 30,000   | 2,450              | 0.25                            | 0.55                             | 17,000                                 | 2,000              | 0.12                            | 0.4                              | 15,000                                 | 1,750              | 0.06                            | 0.29                             |
| 2015-040      | R0.75                    | 4                     | 30,000   | 2,450              | 0.25                            | 0.55                             | 17,000                                 | 2,000              | 0.12                            | 0.4                              | 15,000                                 | 1,750              | 0.06                            | 0.29                             |
| 2015-060      | R0.75                    | 6                     | 30,000   | 2,450              | 0.15                            | 0.45                             | 17,000                                 | 2,000              | 0.07                            | 0.31                             | 15,000                                 | 1,750              | 0.04                            | 0.24                             |
| 2020-030      | R1                       | 3                     | 28,000   | 2,900              | 0.3                             | 0.7                              | 14,000                                 | 2,100              | 0.15                            | 0.5                              | 14,700                                 | 2,100              | 0.15                            | 0.35                             |
| 2020-040      | R1                       | 4                     | 28,000   | 2,900              | 0.3                             | 0.7                              | 14,000                                 | 2,100              | 0.15                            | 0.5                              | 14,700                                 | 2,100              | 0.15                            | 0.35                             |
| 2020-060      | R1                       | 6                     | 28,000   | 2,900              | 0.2                             | 0.6                              | 14,000                                 | 2,100              | 0.1                             | 0.4                              | 14,700                                 | 2,100              | 0.15                            | 0.3                              |
| 2030-060      | R1.5                     | 6                     | 21,000   | 3,000              | 0.4                             | 1                                | 13,250                                 | 2,500              | 0.24                            | 0.55                             | 11,040                                 | 2,280              | 0.24                            | 0.55                             |

2 Flutes

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Square  
Long Neck  
Square

Radius  
Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball  
Long Neck  
Ball

Taper Neck  
Ball

Taper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

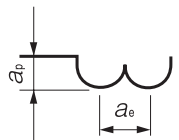
# VHGLB Milling Conditions

| WORK MATERIAL |                          |                       | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                        |                         |
|---------------|--------------------------|-----------------------|--|--------------------|------------------------|-------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min-1)                  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2001-003      | R0.05                    | 0.3                   | 40,000                                 | 120                | 0.002                  | 0.004                   |
| 20015-003     | R0.075                   | 0.3                   | 40,000                                 | 135                | 0.003                  | 0.006                   |
| 2002-005      | R0.1                     | 0.5                   | 36,000                                 | 150                | 0.006                  | 0.018                   |
| 2002-010      | R0.1                     | 1                     | 36,000                                 | 150                | 0.006                  | 0.018                   |
| 2003-010      | R0.15                    | 1                     | 36,000                                 | 250                | 0.008                  | 0.024                   |
| 2003-015      | R0.15                    | 1.5                   | 36,000                                 | 250                | 0.008                  | 0.024                   |
| 2004-010      | R0.2                     | 1                     | 36,000                                 | 350                | 0.01                   | 0.027                   |
| 2004-020      | R0.2                     | 2                     | 36,000                                 | 350                | 0.01                   | 0.027                   |
| 2004-030      | R0.2                     | 3                     | 28,000                                 | 200                | 0.006                  | 0.016                   |
| 2005-015      | R0.25                    | 1.5                   | 30,000                                 | 400                | 0.015                  | 0.03                    |
| 2005-020      | R0.25                    | 2                     | 30,000                                 | 400                | 0.015                  | 0.03                    |
| 2005-025      | R0.25                    | 2.5                   | 30,000                                 | 400                | 0.015                  | 0.03                    |
| 2006-010      | R0.3                     | 1                     | 25,000                                 | 600                | 0.02                   | 0.1                     |
| 2006-015      | R0.3                     | 1.5                   | 25,000                                 | 600                | 0.02                   | 0.1                     |
| 2006-020      | R0.3                     | 2                     | 25,000                                 | 600                | 0.02                   | 0.1                     |
| 2006-030      | R0.3                     | 3                     | 25,000                                 | 500                | 0.02                   | 0.1                     |
| 2006-040      | R0.3                     | 4                     | 25,000                                 | 400                | 0.01                   | 0.075                   |
| 2008-020      | R0.4                     | 2                     | 20,000                                 | 700                | 0.02                   | 0.12                    |
| 2008-040      | R0.4                     | 4                     | 20,000                                 | 700                | 0.02                   | 0.12                    |
| 2010-020      | R0.5                     | 2                     | 16,000                                 | 875                | 0.05                   | 0.2                     |
| 2010-025      | R0.5                     | 2.5                   | 16,000                                 | 875                | 0.05                   | 0.2                     |
| 2010-030      | R0.5                     | 3                     | 16,000                                 | 875                | 0.03                   | 0.17                    |
| 2010-040      | R0.5                     | 4                     | 16,000                                 | 875                | 0.03                   | 0.17                    |
| 2010-060      | R0.5                     | 6                     | 14,500                                 | 525                | 0.025                  | 0.15                    |
| 2015-030      | R0.75                    | 3                     | 11,250                                 | 875                | 0.06                   | 0.29                    |
| 2015-040      | R0.75                    | 4                     | 11,250                                 | 875                | 0.06                   | 0.29                    |
| 2015-060      | R0.75                    | 6                     | 11,250                                 | 875                | 0.04                   | 0.24                    |
| 2020-030      | R1                       | 3                     | 12,250                                 | 1,800              | 0.08                   | 0.35                    |
| 2020-040      | R1                       | 4                     | 12,250                                 | 1,800              | 0.08                   | 0.35                    |
| 2020-060      | R1                       | 6                     | 12,250                                 | 1,800              | 0.06                   | 0.3                     |
| 2030-060      | R1.5                     | 6                     | 9,200                                  | 1,900              | 0.12                   | 0.55                    |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

**Note:**

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when the tool is chattering and heats up to a red color.
- Every coolant offers stable milling.





# VHSLB

Value Series HARDMAX Longneck Ball

## HARDMAX 2 Flutes Short Shank Long Neck Ball End Mills

2 Flutes

NEW

Super  
MG

HARD  
MAX

Shank Dia  
0/-0.003



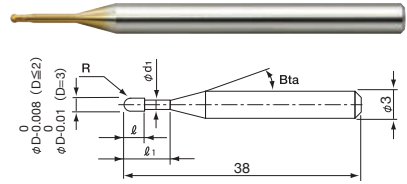
R0.05



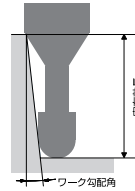
R0.1~R1.5

Back Taper  
Geometry

Except for R0.05~R0.4



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy | Helix Angle |
|---------------------|--------------------|----------------------|-------------|
| R0.05               | 0/-0.008           | ± 0.002              | 0°          |
| R0.1 ~ R0.75        |                    | ± 0.003              | 30°         |
| R1                  |                    | ± 0.004              |             |
| R1.5                | 0/-0.01            | ± 0.005              |             |

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| CARBON STEELS<br>S45C<br>S55C | ALLOY STEELS<br>SK / SCM<br>SUS | PREHARDENED STEELS<br>NAK<br>HPM | HARDENED STEELS |        |        |        |        | CAST IRON | ALUMINUM ALLOYS | GRAPHITE | COPPER | PLASTICS | GLASS FILLED PLASTICS | TITANIUM ALLOYS | HEAT RESISTANT ALLOYS | CEMENTED CARBIDE | HARD BRITTLE (NON-METALLIC) MATERIALS |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●      | ○      |        | ○      |           |                 | ○        |        |          |                       | ○               | ○                     |                  |                                       |

Total 53 models

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Effective Length by Inclined Angles |      |        |      |      | Suggested Retail Price ¥ |
|-----------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|-------------------------------------|------|--------|------|------|--------------------------|
|                 |                       |                        |                   |                          |                       | 30°                                 | 1°   | 1° 30' | 2°   | 3°   |                          |
| VHSLB 2001-003  | R0.05                 | 0.3                    | 0.08              | 0.093                    | 11°                   | 0.34                                | 0.37 | 0.39   | 0.41 | 0.46 | 5,820                    |
| VHSLB 2002-003  | R0.1                  | 0.3                    | 0.16              | 0.18                     | 16°                   | 0.43                                | 0.45 | 0.46   | 0.48 | 0.52 | 4,050                    |
| VHSLB 2002-005  | R0.1                  | 0.5                    | 0.16              | 0.18                     | 16°                   | 0.64                                | 0.66 | 0.69   | 0.71 | 0.76 | 4,050                    |
| VHSLB 2002-0075 | R0.1                  | 0.75                   | 0.16              | 0.18                     | 16°                   | 0.90                                | 0.93 | 0.97   | 1.00 | 1.07 | 4,050                    |
| VHSLB 2002-010  | R0.1                  | 1                      | 0.16              | 0.18                     | 16°                   | 1.16                                | 1.20 | 1.24   | 1.28 | 1.38 | 4,050                    |
| VHSLB 2003-005  | R0.15                 | 0.5                    | 0.24              | 0.28                     | 16°                   | 0.63                                | 0.66 | 0.68   | 0.71 | 0.75 | 3,990                    |
| VHSLB 2003-0075 | R0.15                 | 0.75                   | 0.24              | 0.28                     | 16°                   | 0.90                                | 0.93 | 0.96   | 0.99 | 1.06 | 3,990                    |
| VHSLB 2003-010  | R0.15                 | 1                      | 0.24              | 0.28                     | 16°                   | 1.16                                | 1.20 | 1.24   | 1.28 | 1.37 | 3,990                    |
| VHSLB 2003-015  | R0.15                 | 1.5                    | 0.24              | 0.28                     | 16°                   | 1.67                                | 1.73 | 1.78   | 1.84 | 1.97 | 4,280                    |
| VHSLB 2003-020  | R0.15                 | 2                      | 0.24              | 0.28                     | 16°                   | 2.19                                | 2.26 | 2.33   | 2.41 | 2.59 | 4,280                    |
| VHSLB 2003-030  | R0.15                 | 3                      | 0.24              | 0.28                     | 16°                   | 3.22                                | 3.33 | 3.43   | 3.55 | 3.81 | 4,390                    |
| VHSLB 2004-005  | R0.2                  | 0.5                    | 0.32              | 0.38                     | 16°                   | 0.63                                | 0.65 | 0.68   | 0.70 | 0.74 | 2,740                    |
| VHSLB 2004-010  | R0.2                  | 1                      | 0.32              | 0.38                     | 16°                   | 1.15                                | 1.19 | 1.23   | 1.27 | 1.35 | 2,740                    |
| VHSLB 2004-015  | R0.2                  | 1.5                    | 0.32              | 0.38                     | 16°                   | 1.67                                | 1.73 | 1.78   | 1.84 | 1.96 | 2,800                    |
| VHSLB 2004-020  | R0.2                  | 2                      | 0.32              | 0.38                     | 16°                   | 2.19                                | 2.26 | 2.33   | 2.41 | 2.57 | 2,850                    |
| VHSLB 2004-030  | R0.2                  | 3                      | 0.32              | 0.38                     | 16°                   | 3.22                                | 3.32 | 3.43   | 3.54 | 3.80 | 3,140                    |
| VHSLB 2004-040  | R0.2                  | 4                      | 0.32              | 0.38                     | 16°                   | 4.25                                | 4.39 | 4.53   | 4.68 | 5.02 | 3,420                    |
| VHSLB 2005-010  | R0.25                 | 1                      | 0.4               | 0.48                     | 16°                   | 1.15                                | 1.19 | 1.23   | 1.26 | 1.34 | 2,740                    |
| VHSLB 2005-015  | R0.25                 | 1.5                    | 0.4               | 0.48                     | 16°                   | 1.67                                | 1.72 | 1.77   | 1.83 | 1.95 | 2,740                    |
| VHSLB 2005-020  | R0.25                 | 2                      | 0.4               | 0.48                     | 16°                   | 2.19                                | 2.25 | 2.32   | 2.40 | 2.56 | 2,740                    |
| VHSLB 2005-025  | R0.25                 | 2.5                    | 0.4               | 0.48                     | 16°                   | 2.71                                | 2.79 | 2.87   | 2.97 | 3.18 | 2,740                    |
| VHSLB 2005-030  | R0.25                 | 3                      | 0.4               | 0.48                     | 16°                   | 3.22                                | 3.32 | 3.42   | 3.54 | 3.79 | 2,740                    |
| VHSLB 2005-040  | R0.25                 | 4                      | 0.4               | 0.48                     | 16°                   | 4.25                                | 4.38 | 4.53   | 4.68 | 5.01 | 2,740                    |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## HARDMAX 2 Flutes Short Shank Long Neck Ball End Mills

| Model Number   | Radius of Ball Nose R | Effective Length $\ell_e$ | Length of Cut $\ell_c$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Effective Length by Inclined Angles |                 |                 |                 |                 | Suggested Retail Price $\Psi$ |
|----------------|-----------------------|---------------------------|------------------------|--------------------------|-----------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-------------------------------|
|                |                       |                           |                        |                          |                       | 30°                                 | 1°              | 1° 30'          | 2°              | 3°              |                               |
| VHSLB 2006-010 | R0.3                  | 1                         | 0.48                   | 0.58                     | 16°                   | 1.15                                | 1.19            | 1.22            | 1.26            | 1.33            | 2,340                         |
| VHSLB 2006-015 | R0.3                  | 1.5                       | 0.48                   | 0.58                     | 16°                   | 1.67                                | 1.72            | 1.77            | 1.82            | 1.94            | 2,110                         |
| VHSLB 2006-020 | R0.3                  | 2                         | 0.48                   | 0.58                     | 16°                   | 2.19                                | 2.25            | 2.32            | 2.39            | 2.55            | 2,110                         |
| VHSLB 2006-025 | R0.3                  | 2.5                       | 0.48                   | 0.58                     | 16°                   | 2.70                                | 2.78            | 2.87            | 2.96            | 3.16            | 2,170                         |
| VHSLB 2006-030 | R0.3                  | 3                         | 0.48                   | 0.58                     | 16°                   | 3.22                                | 3.32            | 3.42            | 3.53            | 3.78            | 2,170                         |
| VHSLB 2006-040 | R0.3                  | 4                         | 0.48                   | 0.58                     | 16°                   | 4.25                                | 4.38            | 4.52            | 4.67            | 5.00            | 2,230                         |
| VHSLB 2006-050 | R0.3                  | 5                         | 0.48                   | 0.58                     | 16°                   | 5.28                                | 5.45            | 5.62            | 5.81            | 6.22            | 2,230                         |
| VHSLB 2006-060 | R0.3                  | 6                         | 0.48                   | 0.58                     | 16°                   | 6.31                                | 6.51            | 6.72            | 6.95            | 7.45            | 2,230                         |
| VHSLB 2008-020 | R0.4                  | 2                         | 0.64                   | 0.78                     | 16°                   | 2.18                                | 2.25            | 2.31            | 2.38            | 2.53            | 2,110                         |
| VHSLB 2008-030 | R0.4                  | 3                         | 0.64                   | 0.78                     | 16°                   | 3.22                                | 3.31            | 3.41            | 3.52            | 3.75            | 2,230                         |
| VHSLB 2008-040 | R0.4                  | 4                         | 0.64                   | 0.78                     | 16°                   | 4.25                                | 4.37            | 4.51            | 4.66            | 4.98            | 2,230                         |
| VHSLB 2008-050 | R0.4                  | 5                         | 0.64                   | 0.78                     | 16°                   | 5.28                                | 5.44            | 5.61            | 5.79            | 6.20            | 2,230                         |
| VHSLB 2008-060 | R0.4                  | 6                         | 0.64                   | 0.78                     | 16°                   | 6.31                                | 6.50            | 6.71            | 6.93            | 7.43            | 2,230                         |
| VHSLB 2010-020 | R0.5                  | 2                         | 0.8                    | 0.97                     | 16°                   | 2.20                                | 2.26            | 2.32            | 2.39            | 2.54            | 2,000                         |
| VHSLB 2010-025 | R0.5                  | 2.5                       | 0.8                    | 0.97                     | 16°                   | 2.72                                | 2.79            | 2.87            | 2.96            | 3.15            | 2,000                         |
| VHSLB 2010-030 | R0.5                  | 3                         | 0.8                    | 0.97                     | 16°                   | 3.24                                | 3.33            | 3.42            | 3.53            | 3.76            | 2,000                         |
| VHSLB 2010-040 | R0.5                  | 4                         | 0.8                    | 0.97                     | 16°                   | 4.27                                | 4.39            | 4.52            | 4.67            | 4.98            | 2,000                         |
| VHSLB 2010-050 | R0.5                  | 5                         | 0.8                    | 0.97                     | 16°                   | 5.30                                | 5.46            | 5.62            | 5.80            | 6.21            | 2,000                         |
| VHSLB 2010-060 | R0.5                  | 6                         | 0.8                    | 0.97                     | 16°                   | 6.33                                | 6.52            | 6.72            | 6.94            | 7.43            | 2,170                         |
| VHSLB 2010-080 | R0.5                  | 8                         | 0.8                    | 0.97                     | 16°                   | 8.39                                | 8.65            | 8.93            | 9.22            | 9.88            | 2,170                         |
| VHSLB 2015-030 | R0.75                 | 3                         | 1.2                    | 1.46                     | 16°                   | 3.12                                | 3.20            | 3.28            | 3.37            | 3.58            | 2,050                         |
| VHSLB 2015-040 | R0.75                 | 4                         | 1.2                    | 1.46                     | 16°                   | 4.15                                | 4.26            | 4.38            | 4.51            | 4.80            | 2,050                         |
| VHSLB 2015-060 | R0.75                 | 6                         | 1.2                    | 1.46                     | 16°                   | 6.21                                | 6.39            | 6.58            | 6.79            | 7.25            | 2,050                         |
| VHSLB 2015-080 | R0.75                 | 8                         | 1.2                    | 1.46                     | 16°                   | 8.28                                | 8.52            | 8.78            | 9.07            | 9.69            | 2,170                         |
| VHSLB 2020-030 | R1                    | 3                         | 1.6                    | 1.96                     | 16°                   | 3.11                                | 3.18            | 3.26            | 3.34            | 3.52            | 2,000                         |
| VHSLB 2020-040 | R1                    | 4                         | 1.6                    | 1.96                     | 16°                   | 4.14                                | 4.24            | 4.36            | 4.48            | 4.74            | 2,000                         |
| VHSLB 2020-060 | R1                    | 6                         | 1.6                    | 1.96                     | 16°                   | 6.20                                | 6.37            | 6.56            | 6.75            | 7.19            | 2,000                         |
| VHSLB 2020-080 | R1                    | 8                         | 1.6                    | 1.96                     | 16°                   | 8.27                                | 8.50            | 8.76            | 9.03            | 9.64            | 2,170                         |
| VHSLB 2030-060 | R1.5                  | 6                         | 2.4                    | 2.93                     | —                     | No Interference                     | No Interference | No Interference | No Interference | No Interference | 2,170                         |
| VHSLB 2030-080 | R1.5                  | 8                         | 2.4                    | 2.93                     | —                     | No Interference                     | No Interference | No Interference | No Interference | No Interference | 2,170                         |

Ø3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

# VHSLB Milling Conditions

2 Flutes

| WORK MATERIAL |                          |                       | COPPER<br>OFC / TPC                |                    |                                 |                                  | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001-003      | R0.05                    | 0.3                   | 54,000                             | 85                 | 0.004                           | 0.004                            | 54,000                                   | 85                 | 0.004                           | 0.004                            | 54,000  | 85                 | 0.004                           | 0.004                            |
| 2002-003      | R0.1                     | 0.3                   | 54,000                             | 430                | 0.01                            | 0.01                             | 60,000                                   | 350                | 0.008                           | 0.016                            | 60,000  | 350                | 0.008                           | 0.016                            |
| 2002-005      | R0.1                     | 0.5                   | 54,000                             | 430                | 0.01                            | 0.01                             | 60,000                                   | 350                | 0.008                           | 0.016                            | 60,000  | 350                | 0.008                           | 0.016                            |
| 2002-0075     | R0.1                     | 0.75                  | 54,000                             | 380                | 0.008                           | 0.008                            | 60,000                                   | 320                | 0.007                           | 0.015                            | 60,000  | 320                | 0.007                           | 0.015                            |
| 2002-010      | R0.1                     | 1                     | 54,000                             | 380                | 0.008                           | 0.008                            | 60,000                                   | 250                | 0.005                           | 0.015                            | 60,000  | 250                | 0.005                           | 0.015                            |
| 2003-005      | R0.15                    | 0.5                   | 54,000                             | 720                | 0.015                           | 0.015                            | 43,000                                   | 500                | 0.012                           | 0.024                            | 43,000  | 500                | 0.012                           | 0.024                            |
| 2003-0075     | R0.15                    | 0.75                  | 54,000                             | 720                | 0.015                           | 0.015                            | 43,000                                   | 500                | 0.012                           | 0.024                            | 43,000  | 500                | 0.012                           | 0.024                            |
| 2003-010      | R0.15                    | 1                     | 54,000                             | 640                | 0.014                           | 0.015                            | 43,000                                   | 450                | 0.008                           | 0.024                            | 43,000  | 450                | 0.008                           | 0.024                            |
| 2003-015      | R0.15                    | 1.5                   | 54,000                             | 640                | 0.014                           | 0.015                            | 43,000                                   | 400                | 0.007                           | 0.021                            | 43,000  | 400                | 0.007                           | 0.021                            |
| 2003-020      | R0.15                    | 2                     | 49,000                             | 530                | 0.011                           | 0.011                            | 40,000                                   | 300                | 0.006                           | 0.018                            | 40,000  | 300                | 0.006                           | 0.018                            |
| 2003-030      | R0.15                    | 3                     | 43,000                             | 460                | 0.009                           | 0.01                             | 38,000                                   | 200                | 0.004                           | 0.012                            | 38,000  | 200                | 0.004                           | 0.012                            |
| 2004-005      | R0.2                     | 0.5                   | 54,000                             | 870                | 0.023                           | 0.036                            | 35,000                                   | 1,200              | 0.02                            | 0.04                             | 35,000  | 1,200              | 0.02                            | 0.04                             |
| 2004-010      | R0.2                     | 1                     | 54,000                             | 870                | 0.023                           | 0.036                            | 35,000                                   | 1,200              | 0.02                            | 0.04                             | 35,000  | 1,200              | 0.02                            | 0.04                             |
| 2004-015      | R0.2                     | 1.5                   | 54,000                             | 790                | 0.022                           | 0.036                            | 35,000                                   | 900                | 0.016                           | 0.033                            | 35,000  | 900                | 0.016                           | 0.033                            |
| 2004-020      | R0.2                     | 2                     | 54,000                             | 790                | 0.022                           | 0.036                            | 35,000                                   | 600                | 0.011                           | 0.033                            | 35,000  | 600                | 0.011                           | 0.033                            |
| 2004-030      | R0.2                     | 3                     | 50,000                             | 660                | 0.017                           | 0.018                            | 35,000                                   | 400                | 0.008                           | 0.024                            | 35,000  | 400                | 0.008                           | 0.024                            |
| 2004-040      | R0.2                     | 4                     | 50,000                             | 640                | 0.012                           | 0.018                            | 35,000                                   | 300                | 0.005                           | 0.015                            | 35,000  | 300                | 0.005                           | 0.015                            |
| 2005-010      | R0.25                    | 1                     | 57,000                             | 1,380              | 0.029                           | 0.054                            | 34,000                                   | 1,300              | 0.03                            | 0.06                             | 34,000  | 1,300              | 0.03                            | 0.06                             |
| 2005-015      | R0.25                    | 1.5                   | 57,000                             | 1,380              | 0.029                           | 0.054                            | 34,000                                   | 1,000              | 0.025                           | 0.05                             | 34,000  | 1,000              | 0.025                           | 0.05                             |
| 2005-020      | R0.25                    | 2                     | 57,000                             | 1,250              | 0.028                           | 0.054                            | 34,000                                   | 800                | 0.023                           | 0.046                            | 34,000  | 800                | 0.023                           | 0.046                            |
| 2005-025      | R0.25                    | 2.5                   | 57,000                             | 1,250              | 0.028                           | 0.054                            | 34,000                                   | 700                | 0.015                           | 0.045                            | 34,000  | 700                | 0.015                           | 0.045                            |
| 2005-030      | R0.25                    | 3                     | 55,000                             | 1,010              | 0.021                           | 0.036                            | 32,000                                   | 550                | 0.012                           | 0.036                            | 32,000  | 550                | 0.012                           | 0.036                            |
| 2005-040      | R0.25                    | 4                     | 55,000                             | 1,010              | 0.021                           | 0.036                            | 31,000                                   | 450                | 0.01                            | 0.03                             | 31,000  | 450                | 0.01                            | 0.03                             |
| 2006-010      | R0.3                     | 1                     | 57,000                             | 1,670              | 0.035                           | 0.144                            | 33,000                                   | 1,500              | 0.04                            | 0.08                             | 33,000  | 1,500              | 0.04                            | 0.08                             |
| 2006-015      | R0.3                     | 1.5                   | 57,000                             | 1,670              | 0.035                           | 0.144                            | 33,000                                   | 1,500              | 0.04                            | 0.08                             | 33,000  | 1,500              | 0.04                            | 0.08                             |
| 2006-020      | R0.3                     | 2                     | 57,000                             | 1,540              | 0.034                           | 0.144                            | 33,000                                   | 1,400              | 0.036                           | 0.072                            | 33,000  | 1,400              | 0.036                           | 0.072                            |
| 2006-025      | R0.3                     | 2.5                   | 57,000                             | 1,540              | 0.034                           | 0.144                            | 33,000                                   | 1,200              | 0.033                           | 0.066                            | 33,000  | 1,200              | 0.033                           | 0.066                            |
| 2006-030      | R0.3                     | 3                     | 57,000                             | 1,540              | 0.034                           | 0.144                            | 33,000                                   | 900                | 0.025                           | 0.066                            | 33,000  | 900                | 0.025                           | 0.066                            |
| 2006-040      | R0.3                     | 4                     | 54,000                             | 1,130              | 0.026                           | 0.108                            | 31,000                                   | 700                | 0.02                            | 0.06                             | 31,000  | 700                | 0.02                            | 0.06                             |
| 2006-050      | R0.3                     | 5                     | 46,000                             | 960                | 0.019                           | 0.072                            | 29,000                                   | 440                | 0.015                           | 0.045                            | 29,000  | 440                | 0.015                           | 0.045                            |
| 2006-060      | R0.3                     | 6                     | 46,000                             | 960                | 0.019                           | 0.072                            | 24,000                                   | 380                | 0.012                           | 0.036                            | 24,000  | 380                | 0.012                           | 0.036                            |
| 2008-020      | R0.4                     | 2                     | 55,000                             | 2,060              | 0.063                           | 0.18                             | 30,000                                   | 1,800              | 0.06                            | 0.12                             | 30,000  | 1,800              | 0.06                            | 0.12                             |
| 2008-030      | R0.4                     | 3                     | 55,000                             | 1,860              | 0.063                           | 0.18                             | 30,000                                   | 1,600              | 0.05                            | 0.1                              | 30,000  | 1,600              | 0.05                            | 0.1                              |
| 2008-040      | R0.4                     | 4                     | 55,000                             | 1,860              | 0.063                           | 0.18                             | 30,000                                   | 1,300              | 0.04                            | 0.1                              | 30,000  | 1,300              | 0.04                            | 0.1                              |
| 2008-050      | R0.4                     | 5                     | 47,000                             | 1,410              | 0.038                           | 0.108                            | 30,000                                   | 1,100              | 0.035                           | 0.1                              | 30,000  | 1,100              | 0.035                           | 0.1                              |
| 2008-060      | R0.4                     | 6                     | 47,000                             | 1,410              | 0.038                           | 0.108                            | 27,000                                   | 900                | 0.025                           | 0.075                            | 27,000  | 900                | 0.025                           | 0.075                            |
| 2010-020      | R0.5                     | 2                     | 46,000                             | 2,000              | 0.072                           | 0.36                             | 30,000                                   | 1,600              | 0.08                            | 0.16                             | 30,000  | 1,600              | 0.08                            | 0.16                             |
| 2010-025      | R0.5                     | 2.5                   | 46,000                             | 2,000              | 0.072                           | 0.36                             | 30,000                                   | 1,600              | 0.08                            | 0.16                             | 30,000  | 1,600              | 0.08                            | 0.16                             |
| 2010-030      | R0.5                     | 3                     | 46,000                             | 2,000              | 0.072                           | 0.36                             | 24,000                                   | 1,600              | 0.07                            | 0.14                             | 24,000  | 1,600              | 0.07                            | 0.14                             |
| 2010-040      | R0.5                     | 4                     | 46,000                             | 2,000              | 0.071                           | 0.36                             | 24,000                                   | 1,500              | 0.065                           | 0.13                             | 24,000  | 1,500              | 0.065                           | 0.13                             |
| 2010-050      | R0.5                     | 5                     | 46,000                             | 2,000              | 0.071                           | 0.36                             | 24,000                                   | 1,400              | 0.06                            | 0.12                             | 24,000  | 1,400              | 0.06                            | 0.12                             |
| 2010-060      | R0.5                     | 6                     | 39,000                             | 1,500              | 0.071                           | 0.18                             | 18,000                                   | 1,200              | 0.04                            | 0.12                             | 18,000  | 1,200              | 0.04                            | 0.12                             |
| 2010-080      | R0.5                     | 8                     | 39,000                             | 1,500              | 0.043                           | 0.18                             | 16,500                                   | 900                | 0.027                           | 0.081                            | 16,500  | 900                | 0.027                           | 0.081                            |
| 2015-030      | R0.75                    | 3                     | 30,000                             | 2,200              | 0.171                           | 0.324                            | 30,000                                   | 1,600              | 0.12                            | 0.24                             | 30,000  | 1,600              | 0.12                            | 0.24                             |
| 2015-040      | R0.75                    | 4                     | 30,000                             | 2,200              | 0.171                           | 0.324                            | 30,000                                   | 1,500              | 0.11                            | 0.22                             | 30,000  | 1,500              | 0.11                            | 0.22                             |
| 2015-060      | R0.75                    | 6                     | 30,000                             | 1,980              | 0.147                           | 0.324                            | 23,000                                   | 1,300              | 0.1                             | 0.2                              | 23,000  | 1,300              | 0.1                             | 0.2                              |
| 2015-080      | R0.75                    | 8                     | 26,000                             | 1,500              | 0.106                           | 0.27                             | 18,000                                   | 1,100              | 0.08                            | 0.16                             | 18,000  | 1,100              | 0.08                            | 0.16                             |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

# VHSLB Milling Conditions

| WORK MATERIAL |                          |                       | PREHARDENED STEELS / HARDENED STEELS<br>NAK / STAVAX<br>(~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min-1)  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min-1)                  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min-1)                  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001-003      | R0.05                    | 0.3                   | 48,000   | 55                 | 0.002                           | 0.002                            | 48,000                                 | 45                 | 0.002                           | 0.002                            | 48,000                                 | 45                 | 0.002                           | 0.002                            |
| 2002-003      | R0.1                     | 0.3                   | 60,000   | 200                | 0.003                           | 0.005                            | 60,000                                 | 200                | 0.002                           | 0.003                            | 60,000                                 | 130                | 0.002                           | 0.003                            |
| 2002-005      | R0.1                     | 0.5                   | 60,000   | 200                | 0.003                           | 0.005                            | 60,000                                 | 200                | 0.002                           | 0.003                            | 60,000                                 | 130                | 0.002                           | 0.003                            |
| 2002-0075     | R0.1                     | 0.75                  | 60,000   | 200                | 0.003                           | 0.005                            | 60,000                                 | 200                | 0.002                           | 0.003                            | 60,000                                 | 130                | 0.002                           | 0.003                            |
| 2002-010      | R0.1                     | 1                     | 60,000   | 200                | 0.003                           | 0.005                            | 60,000                                 | 200                | 0.002                           | 0.003                            | 60,000                                 | 130                | 0.002                           | 0.003                            |
| 2003-005      | R0.15                    | 0.5                   | 60,000   | 350                | 0.006                           | 0.008                            | 45,000                                 | 310                | 0.004                           | 0.007                            | 43,500                                 | 180                | 0.003                           | 0.005                            |
| 2003-0075     | R0.15                    | 0.75                  | 60,000   | 350                | 0.006                           | 0.008                            | 45,000                                 | 310                | 0.004                           | 0.007                            | 43,500                                 | 180                | 0.003                           | 0.005                            |
| 2003-010      | R0.15                    | 1                     | 60,000   | 350                | 0.006                           | 0.008                            | 45,000                                 | 310                | 0.004                           | 0.007                            | 43,500                                 | 180                | 0.003                           | 0.005                            |
| 2003-015      | R0.15                    | 1.5                   | 60,000   | 350                | 0.006                           | 0.008                            | 45,000                                 | 310                | 0.004                           | 0.007                            | 43,500                                 | 180                | 0.003                           | 0.005                            |
| 2003-020      | R0.15                    | 2                     | 60,000   | 210                | 0.004                           | 0.007                            | 45,000                                 | 190                | 0.003                           | 0.005                            | 43,500                                 | 110                | 0.002                           | 0.004                            |
| 2003-030      | R0.15                    | 3                     | 42,500   | 140                | 0.002                           | 0.004                            | 32,000                                 | 80                 | 0.002                           | 0.004                            | 32,000                                 | 65                 | 0.001                           | 0.002                            |
| 2004-005      | R0.2                     | 0.5                   | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                                 | 420                | 0.007                           | 0.012                            | 35,000                                 | 240                | 0.005                           | 0.008                            |
| 2004-010      | R0.2                     | 1                     | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                                 | 420                | 0.007                           | 0.012                            | 35,000                                 | 240                | 0.005                           | 0.008                            |
| 2004-015      | R0.2                     | 1.5                   | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                                 | 420                | 0.007                           | 0.012                            | 35,000                                 | 240                | 0.005                           | 0.008                            |
| 2004-020      | R0.2                     | 2                     | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                                 | 420                | 0.007                           | 0.012                            | 35,000                                 | 240                | 0.005                           | 0.008                            |
| 2004-030      | R0.2                     | 3                     | 40,000   | 250                | 0.005                           | 0.008                            | 31,900                                 | 210                | 0.004                           | 0.008                            | 30,500                                 | 160                | 0.003                           | 0.005                            |
| 2004-040      | R0.2                     | 4                     | 32,000   | 180                | 0.003                           | 0.005                            | 25,500                                 | 150                | 0.002                           | 0.004                            | 24,300                                 | 120                | 0.002                           | 0.004                            |
| 2005-010      | R0.25                    | 1                     | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             |
| 2005-015      | R0.25                    | 1.5                   | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             |
| 2005-020      | R0.25                    | 2                     | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             |
| 2005-025      | R0.25                    | 2.5                   | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             |
| 2005-030      | R0.25                    | 3                     | 40,000   | 500                | 0.01                            | 0.02                             | 31,000                                 | 400                | 0.007                           | 0.01                             | 28,550                                 | 230                | 0.005                           | 0.008                            |
| 2005-040      | R0.25                    | 4                     | 32,700   | 180                | 0.005                           | 0.015                            | 27,150                                 | 150                | 0.003                           | 0.008                            | 25,650                                 | 100                | 0.002                           | 0.005                            |
| 2006-010      | R0.3                     | 1                     | 40,000   | 1,400              | 0.045                           | 0.15                             | 30,000                                 | 1,500              | 0.03                            | 0.13                             | 26,500                                 | 1,000              | 0.015                           | 0.09                             |
| 2006-015      | R0.3                     | 1.5                   | 40,000   | 1,100              | 0.03                            | 0.13                             | 30,000                                 | 1,200              | 0.02                            | 0.1                              | 26,500                                 | 800                | 0.01                            | 0.075                            |
| 2006-020      | R0.3                     | 2                     | 40,000   | 1,100              | 0.03                            | 0.13                             | 30,000                                 | 1,200              | 0.02                            | 0.1                              | 26,500                                 | 800                | 0.01                            | 0.075                            |
| 2006-025      | R0.3                     | 2.5                   | 40,000   | 800                | 0.02                            | 0.1                              | 30,000                                 | 800                | 0.015                           | 0.09                             | 26,500                                 | 520                | 0.008                           | 0.065                            |
| 2006-030      | R0.3                     | 3                     | 40,000   | 800                | 0.02                            | 0.1                              | 30,000                                 | 800                | 0.015                           | 0.09                             | 26,500                                 | 520                | 0.008                           | 0.065                            |
| 2006-040      | R0.3                     | 4                     | 40,000   | 500                | 0.015                           | 0.09                             | 30,000                                 | 500                | 0.01                            | 0.075                            | 26,500                                 | 340                | 0.006                           | 0.05                             |
| 2006-050      | R0.3                     | 5                     | 32,000   | 400                | 0.01                            | 0.075                            | 25,000                                 | 390                | 0.007                           | 0.05                             | 23,000                                 | 260                | 0.005                           | 0.04                             |
| 2006-060      | R0.3                     | 6                     | 24,000   | 300                | 0.007                           | 0.06                             | 21,000                                 | 320                | 0.005                           | 0.04                             | 19,500                                 | 210                | 0.004                           | 0.03                             |
| 2008-020      | R0.4                     | 2                     | 35,000   | 1,600              | 0.06                            | 0.21                             | 27,000                                 | 1,600              | 0.04                            | 0.17                             | 23,500                                 | 1,000              | 0.02                            | 0.12                             |
| 2008-030      | R0.4                     | 3                     | 35,000   | 1,400              | 0.05                            | 0.19                             | 27,000                                 | 1,400              | 0.03                            | 0.15                             | 23,500                                 | 900                | 0.015                           | 0.1                              |
| 2008-040      | R0.4                     | 4                     | 35,000   | 1,200              | 0.04                            | 0.17                             | 27,000                                 | 1,200              | 0.025                           | 0.135                            | 23,500                                 | 600                | 0.012                           | 0.095                            |
| 2008-050      | R0.4                     | 5                     | 31,500   | 900                | 0.03                            | 0.15                             | 25,000                                 | 900                | 0.02                            | 0.12                             | 22,000                                 | 500                | 0.01                            | 0.085                            |
| 2008-060      | R0.4                     | 6                     | 28,000   | 600                | 0.02                            | 0.12                             | 23,000                                 | 600                | 0.012                           | 0.095                            | 20,500                                 | 400                | 0.006                           | 0.065                            |
| 2010-020      | R0.5                     | 2                     | 30,000   | 1,750              | 0.2                             | 0.4                              | 24,000                                 | 2,000              | 0.1                             | 0.3                              | 21,000                                 | 1,750              | 0.05                            | 0.2                              |
| 2010-025      | R0.5                     | 2.5                   | 30,000   | 1,750              | 0.2                             | 0.4                              | 24,000                                 | 2,000              | 0.1                             | 0.3                              | 21,000                                 | 1,750              | 0.05                            | 0.2                              |
| 2010-030      | R0.5                     | 3                     | 30,000   | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.05                            | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             |
| 2010-040      | R0.5                     | 4                     | 30,000   | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.05                            | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             |
| 2010-050      | R0.5                     | 5                     | 30,000   | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.05                            | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             |
| 2010-060      | R0.5                     | 6                     | 30,000   | 1,150              | 0.06                            | 0.23                             | 21,500                                 | 1,250              | 0.03                            | 0.17                             | 19,700                                 | 1,050              | 0.025                           | 0.15                             |
| 2010-080      | R0.5                     | 8                     | 24,000   | 800                | 0.025                           | 0.155                            | 18,500                                 | 580                | 0.015                           | 0.12                             | 18,400                                 | 480                | 0.015                           | 0.12                             |
| 2015-030      | R0.75                    | 3                     | 30,000   | 2,450              | 0.25                            | 0.55                             | 17,000                                 | 2,000              | 0.12                            | 0.4                              | 15,000                                 | 1,750              | 0.06                            | 0.29                             |
| 2015-040      | R0.75                    | 4                     | 30,000   | 2,450              | 0.25                            | 0.55                             | 17,000                                 | 2,000              | 0.12                            | 0.4                              | 15,000                                 | 1,750              | 0.06                            | 0.29                             |
| 2015-060      | R0.75                    | 6                     | 30,000   | 2,450              | 0.15                            | 0.45                             | 17,000                                 | 2,000              | 0.07                            | 0.31                             | 15,000                                 | 1,750              | 0.04                            | 0.24                             |
| 2015-080      | R0.75                    | 8                     | 23,500   | 1,300              | 0.1                             | 0.37                             | 15,000                                 | 1,250              | 0.045                           | 0.25                             | 14,000                                 | 1,050              | 0.03                            | 0.21                             |

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

# VHSLB Milling Conditions

2 Flutes

| WORK MATERIAL |                          |                       | HARDENED STEELS<br>HAP72<br>(66-70HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001-003      | R0.05                    | 0.3                   | 36,000                                 | 22                 | 0.002                           | 0.002                            |
| 2002-003      | R0.1                     | 0.3                   | 45,000                                 | 65                 | 0.002                           | 0.003                            |
| 2002-005      | R0.1                     | 0.5                   | 45,000                                 | 65                 | 0.002                           | 0.003                            |
| 2002-0075     | R0.1                     | 0.75                  | 45,000                                 | 65                 | 0.002                           | 0.003                            |
| 2002-010      | R0.1                     | 1                     | 45,000                                 | 65                 | 0.002                           | 0.003                            |
| 2003-005      | R0.15                    | 0.5                   | 32,500                                 | 90                 | 0.003                           | 0.005                            |
| 2003-0075     | R0.15                    | 0.75                  | 32,500                                 | 90                 | 0.003                           | 0.005                            |
| 2003-010      | R0.15                    | 1                     | 32,500                                 | 90                 | 0.003                           | 0.005                            |
| 2003-015      | R0.15                    | 1.5                   | 32,500                                 | 90                 | 0.003                           | 0.005                            |
| 2003-020      | R0.15                    | 2                     | 32,500                                 | 55                 | 0.002                           | 0.004                            |
| 2003-030      | R0.15                    | 3                     | 24,000                                 | 30                 | 0.001                           | 0.002                            |
| 2004-005      | R0.2                     | 0.5                   | 26,250                                 | 120                | 0.005                           | 0.008                            |
| 2004-010      | R0.2                     | 1                     | 26,250                                 | 120                | 0.005                           | 0.008                            |
| 2004-015      | R0.2                     | 1.5                   | 26,250                                 | 120                | 0.005                           | 0.008                            |
| 2004-020      | R0.2                     | 2                     | 26,250                                 | 120                | 0.005                           | 0.008                            |
| 2004-030      | R0.2                     | 3                     | 22,800                                 | 80                 | 0.003                           | 0.005                            |
| 2004-040      | R0.2                     | 4                     | 18,200                                 | 60                 | 0.002                           | 0.004                            |
| 2005-010      | R0.25                    | 1                     | 22,500                                 | 150                | 0.007                           | 0.01                             |
| 2005-015      | R0.25                    | 1.5                   | 22,500                                 | 150                | 0.007                           | 0.01                             |
| 2005-020      | R0.25                    | 2                     | 22,500                                 | 150                | 0.007                           | 0.01                             |
| 2005-025      | R0.25                    | 2.5                   | 22,500                                 | 150                | 0.007                           | 0.01                             |
| 2005-030      | R0.25                    | 3                     | 21,400                                 | 115                | 0.005                           | 0.008                            |
| 2005-040      | R0.25                    | 4                     | 19,900                                 | 50                 | 0.002                           | 0.005                            |
| 2006-010      | R0.3                     | 1                     | 20,000                                 | 500                | 0.015                           | 0.09                             |
| 2006-015      | R0.3                     | 1.5                   | 20,000                                 | 400                | 0.01                            | 0.075                            |
| 2006-020      | R0.3                     | 2                     | 20,000                                 | 400                | 0.01                            | 0.075                            |
| 2006-025      | R0.3                     | 2.5                   | 20,000                                 | 260                | 0.008                           | 0.065                            |
| 2006-030      | R0.3                     | 3                     | 20,000                                 | 260                | 0.008                           | 0.065                            |
| 2006-040      | R0.3                     | 4                     | 20,000                                 | 170                | 0.006                           | 0.05                             |
| 2006-050      | R0.3                     | 5                     | 18,000                                 | 130                | 0.005                           | 0.04                             |
| 2006-060      | R0.3                     | 6                     | 15,000                                 | 105                | 0.004                           | 0.03                             |
| 2008-020      | R0.4                     | 2                     | 17,500                                 | 500                | 0.02                            | 0.12                             |
| 2008-030      | R0.4                     | 3                     | 17,500                                 | 450                | 0.015                           | 0.1                              |
| 2008-040      | R0.4                     | 4                     | 17,500                                 | 300                | 0.012                           | 0.095                            |
| 2008-050      | R0.4                     | 5                     | 16,500                                 | 250                | 0.01                            | 0.085                            |
| 2008-060      | R0.4                     | 6                     | 15,500                                 | 200                | 0.006                           | 0.065                            |
| 2010-020      | R0.5                     | 2                     | 16,000                                 | 875                | 0.05                            | 0.2                              |
| 2010-025      | R0.5                     | 2.5                   | 16,000                                 | 875                | 0.05                            | 0.2                              |
| 2010-030      | R0.5                     | 3                     | 16,000                                 | 875                | 0.03                            | 0.17                             |
| 2010-040      | R0.5                     | 4                     | 16,000                                 | 875                | 0.03                            | 0.17                             |
| 2010-050      | R0.5                     | 5                     | 16,000                                 | 875                | 0.03                            | 0.17                             |
| 2010-060      | R0.5                     | 6                     | 14,500                                 | 525                | 0.025                           | 0.15                             |
| 2010-080      | R0.5                     | 8                     | 13,800                                 | 240                | 0.015                           | 0.12                             |
| 2015-030      | R0.75                    | 3                     | 11,250                                 | 875                | 0.06                            | 0.29                             |
| 2015-040      | R0.75                    | 4                     | 11,250                                 | 875                | 0.06                            | 0.29                             |
| 2015-060      | R0.75                    | 6                     | 11,250                                 | 875                | 0.04                            | 0.24                             |
| 2015-080      | R0.75                    | 8                     | 10,500                                 | 525                | 0.03                            | 0.21                             |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## VHSLB Milling Conditions

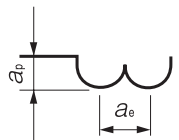
| WORK MATERIAL |                          |                       | COPPER<br>OFC / TPC   |                    |                           |                            | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                           |                            | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                           |                            |
|---------------|--------------------------|-----------------------|-----------------------|--------------------|---------------------------|----------------------------|--|--------------------|---------------------------|----------------------------|---|--------------------|---------------------------|----------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min-1) | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min-1)                    | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min-1)                         | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 2020-030      | R1                       | 3                     | 22,000                | 2,140              | 0.232                     | 0.54                       | 30,000                                   | 2,000              | 0.21                      | 0.42                       | 30,000  | 2,000              | 0.21                      | 0.42                       |
| 2020-040      | R1                       | 4                     | 22,000                | 2,140              | 0.232                     | 0.54                       | 30,000                                   | 2,000              | 0.21                      | 0.42                       | 30,000  | 2,000              | 0.21                      | 0.42                       |
| 2020-060      | R1                       | 6                     | 22,000                | 2,140              | 0.232                     | 0.54                       | 30,000                                   | 2,000              | 0.21                      | 0.42                       | 30,000  | 2,000              | 0.21                      | 0.42                       |
| 2020-080      | R1                       | 8                     | 22,000                | 1,920              | 0.185                     | 0.36                       | 30,000                                   | 2,000              | 0.18                      | 0.36                       | 30,000  | 2,000              | 0.18                      | 0.36                       |
| 2030-060      | R1.5                     | 6                     | 15,000                | 2,890              | 0.278                     | 0.54                       | 24,000                                   | 2,500              | 0.32                      | 0.9                        | 24,000  | 2,500              | 0.32                      | 0.9                        |
| 2030-080      | R1.5                     | 8                     | 15,000                | 2,890              | 0.278                     | 0.54                       | 24,000                                   | 2,500              | 0.32                      | 0.9                        | 24,000  | 2,500              | 0.32                      | 0.9                        |

| WORK MATERIAL |                          |                       | PREHARDENED STEELS / HARDENED STEELS<br>NAK / STAVAX<br>(~55HRC) |                    |                           |                            | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                           |                            | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                           |                            |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------|----------------------------|--|--------------------|---------------------------|----------------------------|--|--------------------|---------------------------|----------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min-1)  | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min-1)                  | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min-1)                  | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 2020-030      | R1                       | 3                     | 28,000   | 2,900              | 0.3                       | 0.7                        | 14,000                                 | 2,100              | 0.15                      | 0.5                        | 12,250                                 | 1,800              | 0.08                      | 0.35                       |
| 2020-040      | R1                       | 4                     | 28,000   | 2,900              | 0.3                       | 0.7                        | 14,000                                 | 2,100              | 0.15                      | 0.5                        | 12,250                                 | 1,800              | 0.08                      | 0.35                       |
| 2020-060      | R1                       | 6                     | 28,000   | 2,900              | 0.2                       | 0.6                        | 14,000                                 | 2,100              | 0.1                       | 0.4                        | 12,250                                 | 1,800              | 0.06                      | 0.3                        |
| 2020-080      | R1                       | 8                     | 28,000   | 2,900              | 0.2                       | 0.6                        | 14,000                                 | 2,100              | 0.1                       | 0.4                        | 12,250                                 | 1,800              | 0.06                      | 0.3                        |
| 2030-060      | R1.5                     | 6                     | 21,000   | 3,000              | 0.4                       | 1                          | 10,500                                 | 2,200              | 0.2                       | 0.7                        | 9,200                                  | 1,900              | 0.12                      | 0.55                       |
| 2030-080      | R1.5                     | 8                     | 21,000   | 3,000              | 0.4                       | 1                          | 10,500                                 | 2,200              | 0.2                       | 0.7                        | 9,200                                  | 1,900              | 0.12                      | 0.55                       |

| WORK MATERIAL |                          |                       | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                           |                            |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------|----------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min-1)                  | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 2020-030      | R1                       | 3                     | 9,200                                  | 900                | 0.08                      | 0.35                       |
| 2020-040      | R1                       | 4                     | 9,200                                  | 900                | 0.08                      | 0.35                       |
| 2020-060      | R1                       | 6                     | 9,200                                  | 900                | 0.06                      | 0.3                        |
| 2020-080      | R1                       | 8                     | 9,200                                  | 900                | 0.06                      | 0.3                        |
| 2030-060      | R1.5                     | 6                     | 6,900                                  | 950                | 0.12                      | 0.55                       |
| 2030-080      | R1.5                     | 8                     | 6,900                                  | 950                | 0.12                      | 0.55                       |

**Note:**

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when the tool is chattering and heats up to a red color.
- Every coolant offers stable milling.
- Recommend wet coolant for Copper.



# Long neck ball end mill R0.5 x Effective length 6mm

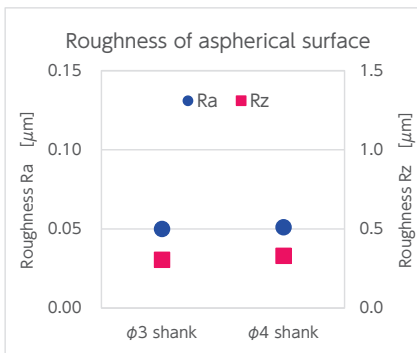
## The comparison example of different shank diameter between $\phi 3\text{mm}$ & $\phi 4\text{mm}$

### Comparison of roughness and reflection of the aspherical surface (Finishing process).

The upper surface of the square prism was processed aspherically, and the surface roughness and reflection were compared. We obtained the same results as the  $\phi 4\text{mm}$  shank in terms of surface roughness and reflection.

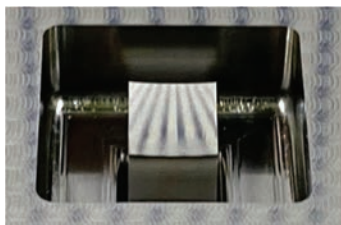
<Condition>

- Work material : HAP10(64HRC)
- Coolant : Air blow
- Tool holder : Hydraulic chuck
- Milling shape : Aspherical surface ( $5\text{mm} \times 5\text{mm}$ ) R25
- Cycle time : about 26 min.
- $n$  : 29,600  $\text{min}^{-1}$
- $V_r$  : 500  $\text{mm}/\text{min}$
- $a_p$  : 0.015  $\text{mm}$
- $a_e$  : 0.006  $\text{mm}$



<Aspherical shape photos>

$\phi 3\text{mm}$  shank VHSLB



$\phi 4\text{mm}$  shank HSLB

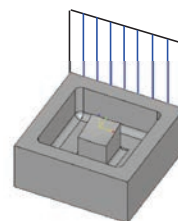
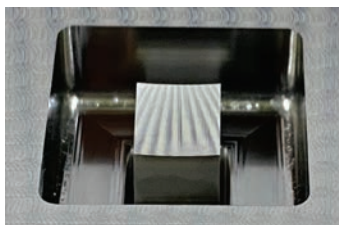


Image of the time of shooting

\* These photos were taken as shown in the image on the right so that the blue line printed on the paper would be reflected.

$\phi 3\text{mm}$  Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball  
Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper  
Taper

Barrel

Spiral V Cutter

Drill

Technical Data

# VCSELB

Value Series UTCOAT Longneck Ball

## UTCOAT 2 Flutes Short Shank Long Neck Ball End Mills

NEW

Super  
MG

UT  
COAT

Shank Dia  
0/-0.003



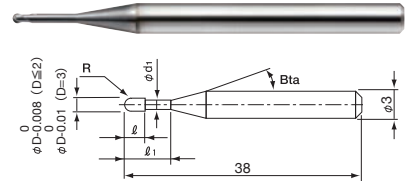
R0.05~R0.075



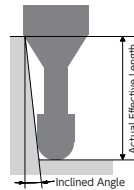
R0.1~R1.5

Back Taper  
Geometry

Except for R0.05~R0.15



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy | Helix Angle |
|---------------------|--------------------|----------------------|-------------|
| R0.05 ~ R0.075      | 0/-0.008           | ± 0.002              | 0°          |
| R0.1 ~ R0.75        |                    | ± 0.003              | 30°         |
| R1                  | ± 0.004            |                      |             |
| R1.5                | 0/-0.01            | ± 0.005              |             |

### Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| CARBON STEELS<br>S45C<br>S55C | ALLOY STEELS<br>SK / SCM<br>SUS | PREHARDENED STEELS<br>NAK<br>HPM | HARDENED STEELS |        |        |        |        | CAST IRON | ALUMINUM ALLOYS | GRAPHITE | COPPER | PLASTICS | GLASS FILLED PLASTICS | TITANIUM ALLOYS | HEAT RESISTANT ALLOYS | CEMENTED CARBIDE | HARD BRITTLE (NON-METALLIC) MATERIALS |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        | ○         | ●               |          | ●      |          |                       |                 |                       |                  |                                       |

### Total 30 models

Unit (mm)

| Model Number     | Radius of Ball Nose R | Effective Length $\phi_1$ | Length of Cut $\phi$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Effective Length by Inclined Angles |      |        |      |      | Suggested Retail Price ¥ |
|------------------|-----------------------|---------------------------|----------------------|--------------------------|-----------------------|-------------------------------------|------|--------|------|------|--------------------------|
|                  |                       |                           |                      |                          |                       | 30°                                 | 1°   | 1° 30' | 2°   | 3°   |                          |
| VCSELB 2001-003  | R0.05                 | 0.3                       | 0.08                 | 0.094                    | 11°                   | 0.34                                | 0.36 | 0.38   | 0.41 | 0.46 | 5,820                    |
| VCSELB 20015-003 | R0.075                | 0.3                       | 0.12                 | 0.14                     | 11°                   | 0.37                                | 0.39 | 0.41   | 0.43 | 0.48 | 6,730                    |
| VCSELB 2002-005  | R0.1                  | 0.5                       | 0.16                 | 0.18                     | 11°                   | 0.64                                | 0.67 | 0.70   | 0.73 | 0.82 | 4,050                    |
| VCSELB 2002-010  | R0.1                  | 1                         | 0.16                 | 0.18                     | 11°                   | 1.16                                | 1.21 | 1.28   | 1.34 | 1.50 | 4,050                    |
| VCSELB 2003-010  | R0.15                 | 1                         | 0.24                 | 0.28                     | 11°                   | 1.16                                | 1.21 | 1.27   | 1.33 | 1.49 | 3,990                    |
| VCSELB 2003-020  | R0.15                 | 2                         | 0.24                 | 0.28                     | 11°                   | 2.20                                | 2.30 | 2.42   | 2.55 | 2.85 | 4,280                    |
| VCSELB 2003-030  | R0.15                 | 3                         | 0.24                 | 0.28                     | 11°                   | 3.25                                | 3.40 | 3.58   | 3.77 | 4.22 | 4,390                    |
| VCSELB 2004-010  | R0.2                  | 1                         | 0.32                 | 0.38                     | 11°                   | 1.16                                | 1.21 | 1.26   | 1.32 | 1.47 | 2,740                    |
| VCSELB 2004-020  | R0.2                  | 2                         | 0.32                 | 0.38                     | 11°                   | 2.20                                | 2.30 | 2.41   | 2.54 | 2.83 | 2,850                    |
| VCSELB 2004-030  | R0.2                  | 3                         | 0.32                 | 0.38                     | 11°                   | 3.24                                | 3.40 | 3.57   | 3.76 | 4.20 | 3,140                    |
| VCSELB 2004-040  | R0.2                  | 4                         | 0.32                 | 0.38                     | 11°                   | 4.29                                | 4.50 | 4.72   | 4.97 | 5.57 | 3,420                    |
| VCSELB 2005-020  | R0.25                 | 2                         | 0.4                  | 0.48                     | 11°                   | 2.19                                | 2.29 | 2.40   | 2.52 | 2.81 | 2,740                    |
| VCSELB 2005-030  | R0.25                 | 3                         | 0.4                  | 0.48                     | 11°                   | 3.24                                | 3.39 | 3.56   | 3.74 | 4.18 | 2,740                    |
| VCSELB 2005-040  | R0.25                 | 4                         | 0.4                  | 0.48                     | 11°                   | 4.29                                | 4.49 | 4.71   | 4.96 | 5.55 | 2,740                    |
| VCSELB 2006-020  | R0.3                  | 2                         | 0.48                 | 0.58                     | 11°                   | 2.19                                | 2.29 | 2.39   | 2.51 | 2.79 | 2,110                    |
| VCSELB 2006-030  | R0.3                  | 3                         | 0.48                 | 0.58                     | 11°                   | 3.24                                | 3.39 | 3.55   | 3.73 | 4.16 | 2,170                    |
| VCSELB 2006-040  | R0.3                  | 4                         | 0.48                 | 0.58                     | 11°                   | 4.28                                | 4.48 | 4.70   | 4.95 | 5.53 | 2,230                    |
| VCSELB 2006-060  | R0.3                  | 6                         | 0.48                 | 0.58                     | 11°                   | 6.38                                | 6.68 | 7.02   | 7.39 | 8.27 | 2,230                    |
| VCSELB 2008-020  | R0.4                  | 2                         | 0.64                 | 0.78                     | 11°                   | 2.19                                | 2.28 | 2.38   | 2.49 | 2.76 | 2,110                    |
| VCSELB 2008-040  | R0.4                  | 4                         | 0.64                 | 0.78                     | 11°                   | 4.28                                | 4.47 | 4.69   | 4.93 | 5.50 | 2,230                    |
| VCSELB 2008-060  | R0.4                  | 6                         | 0.64                 | 0.78                     | 11°                   | 6.37                                | 6.67 | 7.00   | 7.37 | 8.23 | 2,230                    |



## UTCOAT 2 Flutes Short Shank Long Neck Ball End Mills

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Effective Length by Inclined Angles |                 |                 |                 |                 | Suggested Retail Price ¥ |
|-----------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|--------------------------|
|                 |                       |                        |                   |                          |                       | 30°                                 | 1°              | 1° 30'          | 2°              | 3°              |                          |
| VCSELB 2010-030 | R0.5                  | 3                      | 0.8               | 0.97                     | 11°                   | 3.26                                | 3.40            | 3.55            | 3.73            | 4.13            | 2,000                    |
| VCSELB 2010-040 | R0.5                  | 4                      | 0.8               | 0.97                     | 11°                   | 4.31                                | 4.50            | 4.71            | 4.94            | 5.50            | 2,000                    |
| VCSELB 2010-050 | R0.5                  | 5                      | 0.8               | 0.97                     | 11°                   | 5.35                                | 5.60            | 5.87            | 6.16            | 6.87            | 2,000                    |
| VCSELB 2010-060 | R0.5                  | 6                      | 0.8               | 0.97                     | 11°                   | 6.40                                | 6.70            | 7.02            | 7.38            | 8.24            | 2,170                    |
| VCSELB 2015-040 | R0.75                 | 4                      | 1.2               | 1.46                     | 11°                   | 4.25                                | 4.42            | 4.62            | 4.84            | 5.35            | 2,050                    |
| VCSELB 2015-060 | R0.75                 | 6                      | 1.2               | 1.46                     | 11°                   | 6.34                                | 6.62            | 6.93            | 7.27            | 8.09            | 2,050                    |
| VCSELB 2020-040 | R1                    | 4                      | 1.6               | 1.96                     | 11°                   | 4.24                                | 4.40            | 4.58            | 4.78            | 5.26            | 2,000                    |
| VCSELB 2020-060 | R1                    | 6                      | 1.6               | 1.96                     | 11°                   | 6.33                                | 6.60            | 6.89            | 7.22            | 8.00            | 2,000                    |
| VCSELB 2030-060 | R1.5                  | 6                      | 2.4               | 2.93                     | —                     | No Interference                     | No Interference | No Interference | No Interference | No Interference | 2,170                    |

2 Flutes

ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral

Spiral  
V Cutter

Drill

Drill

Technical Data

Technical Data

# VCSELB Milling Conditions

| WORK MATERIAL |                          |                       | COPPER / ALUMINUM ALLOYS           |                    |                                 |                                  | CARBON STEELS / ALLOY STEELS<br>S45C / S50C / SK / SCM<br>(~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>NAK80 / STAVAX / HPM38<br>(30~45HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                                 | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001-003      | R0.05                    | 0.3                   | 54,000                             | 85                 | 0.004                           | 0.004                            | 54,000   | 85                 | 0.004                           | 0.004                            | 48,000   | 55                 | 0.002                           | 0.002                            |
| 20015-003     | R0.075                   | 0.3                   | 54,000                             | 160                | 0.007                           | 0.009                            | 54,000   | 160                | 0.007                           | 0.009                            | 48,000   | 90                 | 0.004                           | 0.004                            |
| 2002-005      | R0.1                     | 0.5                   | 60,000                             | 350                | 0.008                           | 0.024                            | 60,000   | 350                | 0.008                           | 0.016                            | 60,000   | 300                | 0.008                           | 0.024                            |
| 2002-010      | R0.1                     | 1                     | 60,000                             | 250                | 0.006                           | 0.018                            | 60,000   | 250                | 0.005                           | 0.015                            | 60,000   | 250                | 0.006                           | 0.018                            |
| 2003-010      | R0.15                    | 1                     | 43,000                             | 450                | 0.01                            | 0.03                             | 43,000   | 450                | 0.008                           | 0.024                            | 54,000   | 400                | 0.01                            | 0.03                             |
| 2003-020      | R0.15                    | 2                     | 40,000                             | 300                | 0.006                           | 0.018                            | 40,000   | 300                | 0.006                           | 0.018                            | 50,000   | 300                | 0.007                           | 0.021                            |
| 2003-030      | R0.15                    | 3                     | 38,000                             | 200                | 0.004                           | 0.012                            | 38,000   | 200                | 0.004                           | 0.012                            | 42,000   | 200                | 0.004                           | 0.012                            |
| 2004-010      | R0.2                     | 1                     | 35,000                             | 1,200              | 0.03                            | 0.09                             | 35,000   | 1,200              | 0.02                            | 0.04                             | 50,000   | 650                | 0.025                           | 0.075                            |
| 2004-020      | R0.2                     | 2                     | 35,000                             | 600                | 0.015                           | 0.045                            | 35,000   | 600                | 0.011                           | 0.033                            | 50,000   | 500                | 0.015                           | 0.045                            |
| 2004-030      | R0.2                     | 3                     | 35,000                             | 400                | 0.01                            | 0.03                             | 35,000   | 400                | 0.008                           | 0.024                            | 42,000   | 400                | 0.01                            | 0.03                             |
| 2004-040      | R0.2                     | 4                     | 35,000                             | 300                | 0.005                           | 0.015                            | 35,000   | 300                | 0.005                           | 0.015                            | 35,000   | 300                | 0.005                           | 0.015                            |
| 2005-020      | R0.25                    | 2                     | 34,000                             | 800                | 0.025                           | 0.075                            | 34,000   | 800                | 0.023                           | 0.046                            | 45,000   | 700                | 0.022                           | 0.066                            |
| 2005-030      | R0.25                    | 3                     | 32,000                             | 550                | 0.016                           | 0.048                            | 32,000   | 550                | 0.012                           | 0.036                            | 41,000   | 550                | 0.014                           | 0.042                            |
| 2005-040      | R0.25                    | 4                     | 31,000                             | 450                | 0.012                           | 0.036                            | 31,000   | 450                | 0.01                            | 0.03                             | 35,000   | 450                | 0.01                            | 0.03                             |
| 2006-020      | R0.3                     | 2                     | 33,000                             | 1,400              | 0.045                           | 0.135                            | 33,000   | 1,400              | 0.036                           | 0.072                            | 40,000   | 1,200              | 0.045                           | 0.09                             |
| 2006-030      | R0.3                     | 3                     | 33,000                             | 900                | 0.035                           | 0.105                            | 33,000   | 900                | 0.025                           | 0.066                            | 40,000   | 800                | 0.03                            | 0.075                            |
| 2006-040      | R0.3                     | 4                     | 31,000                             | 700                | 0.027                           | 0.081                            | 31,000   | 700                | 0.02                            | 0.06                             | 35,000   | 560                | 0.022                           | 0.066                            |
| 2006-060      | R0.3                     | 6                     | 24,000                             | 380                | 0.012                           | 0.036                            | 24,000   | 380                | 0.012                           | 0.036                            | 24,000   | 380                | 0.01                            | 0.03                             |
| 2008-020      | R0.4                     | 2                     | 30,000                             | 2,200              | 0.1                             | 0.3                              | 30,000   | 1,800              | 0.06                            | 0.12                             | 35,000   | 1,800              | 0.07                            | 0.14                             |
| 2008-040      | R0.4                     | 4                     | 30,000                             | 1,400              | 0.07                            | 0.21                             | 30,000   | 1,300              | 0.04                            | 0.1                              | 35,000   | 1,300              | 0.05                            | 0.12                             |
| 2008-060      | R0.4                     | 6                     | 27,000                             | 900                | 0.04                            | 0.12                             | 27,000   | 900                | 0.025                           | 0.075                            | 27,000   | 800                | 0.03                            | 0.09                             |
| 2010-030      | R0.5                     | 3                     | 30,000                             | 1,800              | 0.11                            | 0.33                             | 24,000   | 1,600              | 0.07                            | 0.14                             | 30,000   | 1,500              | 0.08                            | 0.16                             |
| 2010-040      | R0.5                     | 4                     | 30,000                             | 1,700              | 0.09                            | 0.27                             | 24,000   | 1,500              | 0.065                           | 0.13                             | 30,000   | 1,300              | 0.075                           | 0.15                             |
| 2010-050      | R0.5                     | 5                     | 30,000                             | 1,600              | 0.08                            | 0.24                             | 24,000   | 1,400              | 0.06                            | 0.12                             | 30,000   | 1,200              | 0.07                            | 0.14                             |
| 2010-060      | R0.5                     | 6                     | 30,000                             | 1,400              | 0.06                            | 0.18                             | 18,000   | 1,200              | 0.04                            | 0.12                             | 30,000   | 1,100              | 0.06                            | 0.12                             |
| 2015-040      | R0.75                    | 4                     | 30,000                             | 1,800              | 0.14                            | 0.42                             | 30,000   | 1,500              | 0.11                            | 0.22                             | 30,000   | 1,600              | 0.11                            | 0.22                             |
| 2015-060      | R0.75                    | 6                     | 30,000                             | 1,800              | 0.12                            | 0.36                             | 23,000   | 1,300              | 0.1                             | 0.2                              | 30,000   | 1,400              | 0.1                             | 0.2                              |
| 2020-040      | R1                       | 4                     | 30,000                             | 2,000              | 0.2                             | 0.6                              | 30,000   | 2,000              | 0.21                            | 0.42                             | 30,000   | 2,000              | 0.2                             | 0.6                              |
| 2020-060      | R1                       | 6                     | 30,000                             | 2,000              | 0.2                             | 0.6                              | 30,000   | 2,000              | 0.21                            | 0.42                             | 30,000   | 2,000              | 0.2                             | 0.6                              |
| 2030-060      | R1.5                     | 6                     | 24,000                             | 2,500              | 0.32                            | 0.9                              | 24,000   | 2,500              | 0.32                            | 0.9                              | 24,000   | 2,500              | 0.3                             | 0.9                              |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

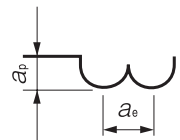
## VCSELB Milling Conditions

2 Flutes

| WORK MATERIAL |                          |                       | HARDENED STEELS<br>STAVAX / HPM38 / SKD61<br>(45~55HRC) |                    |                           |                            |
|---------------|--------------------------|-----------------------|---|--------------------|---------------------------|----------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                      | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 2001-003      | R0.05                    | 0.3                   | 48,000  | 55                 | 0.002                     | 0.002                      |
| 20015-003     | R0.075                   | 0.3                   | 48,000  | 90                 | 0.004                     | 0.004                      |
| 2002-005      | R0.1                     | 0.5                   | 60,000  | 300                | 0.006                     | 0.018                      |
| 2002-010      | R0.1                     | 1                     | 60,000  | 220                | 0.005                     | 0.015                      |
| 2003-010      | R0.15                    | 1                     | 43,000  | 400                | 0.007                     | 0.021                      |
| 2003-020      | R0.15                    | 2                     | 40,000  | 300                | 0.005                     | 0.015                      |
| 2003-030      | R0.15                    | 3                     | 38,000  | 200                | 0.004                     | 0.008                      |
| 2004-010      | R0.2                     | 1                     | 35,000  | 650                | 0.015                     | 0.045                      |
| 2004-020      | R0.2                     | 2                     | 35,000  | 400                | 0.01                      | 0.03                       |
| 2004-030      | R0.2                     | 3                     | 35,000  | 330                | 0.007                     | 0.021                      |
| 2004-040      | R0.2                     | 4                     | 35,000  | 250                | 0.005                     | 0.015                      |
| 2005-020      | R0.25                    | 2                     | 32,000  | 700                | 0.016                     | 0.048                      |
| 2005-030      | R0.25                    | 3                     | 31,000  | 500                | 0.012                     | 0.036                      |
| 2005-040      | R0.25                    | 4                     | 30,000  | 390                | 0.01                      | 0.03                       |
| 2006-020      | R0.3                     | 2                     | 30,000  | 1,200              | 0.036                     | 0.054                      |
| 2006-030      | R0.3                     | 3                     | 30,000  | 900                | 0.026                     | 0.052                      |
| 2006-040      | R0.3                     | 4                     | 28,000  | 600                | 0.018                     | 0.054                      |
| 2006-060      | R0.3                     | 6                     | 24,000  | 380                | 0.008                     | 0.024                      |
| 2008-020      | R0.4                     | 2                     | 25,000  | 1,700              | 0.07                      | 0.1                        |
| 2008-040      | R0.4                     | 4                     | 25,000  | 1,200              | 0.045                     | 0.09                       |
| 2008-060      | R0.4                     | 6                     | 23,000  | 800                | 0.023                     | 0.069                      |
| 2010-030      | R0.5                     | 3                     | 21,500  | 1,400              | 0.08                      | 0.12                       |
| 2010-040      | R0.5                     | 4                     | 21,500  | 1,300              | 0.075                     | 0.1                        |
| 2010-050      | R0.5                     | 5                     | 21,500  | 1,200              | 0.06                      | 0.09                       |
| 2010-060      | R0.5                     | 6                     | 21,500  | 1,100              | 0.05                      | 0.1                        |
| 2015-040      | R0.75                    | 4                     | 18,000  | 1,400              | 0.11                      | 0.17                       |
| 2015-060      | R0.75                    | 6                     | 15,000  | 1,200              | 0.1                       | 0.16                       |
| 2020-040      | R1                       | 4                     | 16,000  | 1,300              | 0.17                      | 0.5                        |
| 2020-060      | R1                       | 6                     | 14,000  | 1,100              | 0.15                      | 0.4                        |
| 2030-060      | R1.5                     | 6                     | 14,000  | 1,400              | 0.25                      | 0.76                       |

**Note:**

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when the tool is chattering and heats up to a red color.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend wet coolant for Copper.



Ø3mm Shank V Series  
UDC-PCD Series  
CBN Series  
Square  
Long Neck Square  
Radius  
Long Neck Radius  
Taper Neck Radius  
Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball  
Taper  
Barrel  
Spiral V Cutter  
Drill  
Technical Data

# VDLCLB

Value Series DLCCOAT Longneck Ball

## DLCCOAT 2 Flutes Short Shank Long Neck Ball End Mills

NEW

Super  
MG

DLC



R  
±0.002

R  
±0.003

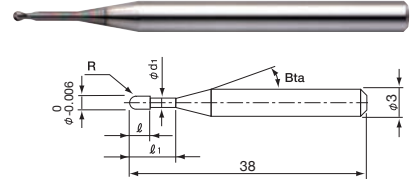
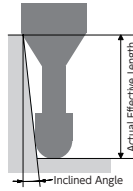
Shank Dia  
0/-0.003

R0.05~R0.2

R0.25~R1

Back Taper  
Geometry

Except for R0.05~R0.15



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Label Sample



#001 φD0.997 R+0.001/-0.001

Diameter and Ball R accuracy measurements are printed on the label to support High Precision milling.

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

|  | CARBON STEELS<br>S45C<br>S55C | ALLOY STEELS<br>SK / SCM<br>SUS | PREHARDENED STEELS<br>NAK<br>HPM | HARDENED STEELS |        |        |        |        | CAST IRON | ALUMINUM ALLOYS | GRAPHITE | COPPER | PLASTICS | GLASS FILLED PLASTICS | TITANIUM ALLOYS | HEAT RESISTANT ALLOYS | CEMENTED CARBIDE | HARD BRITTLE (NON-METALLIC) MATERIALS |
|--|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
|  |                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|  |                               |                                 |                                  |                 |        |        |        |        | ●         |                 | ★        |        |          |                       |                 |                       |                  |                                       |

Total 32 models

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Effective Length by Inclined Angles |      |        |      |                 | Suggested Retail Price ¥ |
|-----------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|-------------------------------------|------|--------|------|-----------------|--------------------------|
|                 |                       |                        |                   |                          |                       | 30°                                 | 1°   | 1° 30' | 2°   | 3°              |                          |
| VDLCLB 2001-003 | R0.05                 | 0.3                    | 0.08              | 0.092                    | 11°                   | 0.35                                | 0.37 | 0.39   | 0.41 | 0.46            | 5,300                    |
| VDLCLB 2001-005 | R0.05                 | 0.5                    | 0.08              | 0.092                    | 11°                   | 0.56                                | 0.59 | 0.62   | 0.66 | 0.74            | 5,500                    |
| VDLCLB 2002-005 | R0.1                  | 0.5                    | 0.16              | 0.18                     | 11°                   | 0.64                                | 0.67 | 0.70   | 0.74 | 0.83            | 4,250                    |
| VDLCLB 2002-010 | R0.1                  | 1                      | 0.16              | 0.18                     | 11°                   | 1.17                                | 1.22 | 1.28   | 1.35 | 1.51            | 4,450                    |
| VDLCLB 2002-015 | R0.1                  | 1.5                    | 0.16              | 0.18                     | 11°                   | 1.68                                | 1.77 | 1.86   | 1.95 | 2.19            | 4,600                    |
| VDLCLB 2003-010 | R0.15                 | 1                      | 0.24              | 0.28                     | 11°                   | 1.16                                | 1.22 | 1.27   | 1.34 | 1.49            | 4,450                    |
| VDLCLB 2003-020 | R0.15                 | 2                      | 0.24              | 0.28                     | 11°                   | 2.21                                | 2.31 | 2.43   | 2.55 | 2.86            | 4,800                    |
| VDLCLB 2004-010 | R0.2                  | 1                      | 0.32              | 0.38                     | 11°                   | 1.16                                | 1.21 | 1.27   | 1.33 | 1.48            | 3,850                    |
| VDLCLB 2004-020 | R0.2                  | 2                      | 0.32              | 0.38                     | 11°                   | 2.20                                | 2.31 | 2.42   | 2.54 | 2.84            | 3,950                    |
| VDLCLB 2004-030 | R0.2                  | 3                      | 0.32              | 0.38                     | 11°                   | 3.25                                | 3.40 | 3.57   | 3.76 | 4.21            | 4,000                    |
| VDLCLB 2004-040 | R0.2                  | 4                      | 0.32              | 0.38                     | 11°                   | 4.30                                | 4.50 | 4.73   | 4.98 | 5.58            | 4,100                    |
| VDLCLB 2005-020 | R0.25                 | 2                      | 0.4               | 0.48                     | 11°                   | 2.20                                | 2.30 | 2.41   | 2.53 | 2.82            | 3,800                    |
| VDLCLB 2005-030 | R0.25                 | 3                      | 0.4               | 0.48                     | 11°                   | 3.25                                | 3.40 | 3.57   | 3.75 | 4.19            | 3,850                    |
| VDLCLB 2005-040 | R0.25                 | 4                      | 0.4               | 0.48                     | 11°                   | 4.29                                | 4.50 | 4.72   | 4.97 | 5.56            | 3,950                    |
| VDLCLB 2006-020 | R0.3                  | 2                      | 0.48              | 0.58                     | 11°                   | 2.20                                | 2.30 | 2.40   | 2.52 | 2.80            | 2,950                    |
| VDLCLB 2006-030 | R0.3                  | 3                      | 0.48              | 0.58                     | 11°                   | 3.25                                | 3.39 | 3.56   | 3.74 | 4.17            | 3,050                    |
| VDLCLB 2006-040 | R0.3                  | 4                      | 0.48              | 0.58                     | 11°                   | 4.29                                | 4.49 | 4.71   | 4.96 | 5.54            | 3,100                    |
| VDLCLB 2006-050 | R0.3                  | 5                      | 0.48              | 0.58                     | 11°                   | 5.34                                | 5.59 | 5.87   | 6.18 | 6.91            | 3,200                    |
| VDLCLB 2006-060 | R0.3                  | 6                      | 0.48              | 0.58                     | 11°                   | 6.39                                | 6.69 | 7.03   | 7.40 | 8.28            | 3,250                    |
| VDLCLB 2008-030 | R0.4                  | 3                      | 0.64              | 0.78                     | 11°                   | 3.24                                | 3.38 | 3.54   | 3.72 | 4.14            | 3,050                    |
| VDLCLB 2008-040 | R0.4                  | 4                      | 0.64              | 0.78                     | 11°                   | 4.29                                | 4.48 | 4.70   | 4.94 | 5.51            | 3,100                    |
| VDLCLB 2008-060 | R0.4                  | 6                      | 0.64              | 0.78                     | 11°                   | 6.38                                | 6.68 | 7.01   | 7.38 | 8.24            | 3,200                    |
| VDLCLB 2010-020 | R0.5                  | 2                      | 0.8               | 0.97                     | 11°                   | 2.22                                | 2.31 | 2.41   | 2.52 | 2.77            | 2,900                    |
| VDLCLB 2010-030 | R0.5                  | 3                      | 0.8               | 0.97                     | 11°                   | 3.27                                | 3.41 | 3.56   | 3.73 | 4.14            | 2,900                    |
| VDLCLB 2010-040 | R0.5                  | 4                      | 0.8               | 0.97                     | 11°                   | 4.32                                | 4.51 | 4.72   | 4.95 | 5.51            | 2,900                    |
| VDLCLB 2010-060 | R0.5                  | 6                      | 0.8               | 0.97                     | 11°                   | 6.41                                | 6.70 | 7.03   | 7.39 | 8.25            | 2,950                    |
| VDLCLB 2010-080 | R0.5                  | 8                      | 0.8               | 0.97                     | 11°                   | 8.50                                | 8.90 | 9.34   | 9.83 | 10.99           | 3,100                    |
| VDLCLB 2015-040 | R0.75                 | 4                      | 1.2               | 1.45                     | 11°                   | 4.26                                | 4.43 | 4.63   | 4.85 | 5.36            | 2,950                    |
| VDLCLB 2015-060 | R0.75                 | 6                      | 1.2               | 1.45                     | 11°                   | 6.35                                | 6.63 | 6.94   | 7.28 | 8.10            | 2,950                    |
| VDLCLB 2020-040 | R1                    | 4                      | 1.6               | 1.95                     | 11°                   | 4.25                                | 4.41 | 4.59   | 4.79 | 5.27            | 3,050                    |
| VDLCLB 2020-060 | R1                    | 6                      | 1.6               | 1.95                     | 11°                   | 6.34                                | 6.61 | 6.90   | 7.23 | 8.01            | 3,050                    |
| VDLCLB 2020-080 | R1                    | 8                      | 1.6               | 1.95                     | 11°                   | 8.43                                | 8.80 | 9.21   | 9.67 | No Interference | 3,100                    |

# VDLCLB Milling Conditions

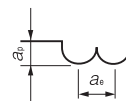
2 Flutes

| WORK MATERIAL |                          |                       | COPPER / ALUMINUM ALLOY            |                    |                                 |                                  | TUNGSTEN COPPER                    |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001-003      | R0.05                    | 0.3                   | 43,600                             | 220                | 0.01                            | 0.01                             | 32,700                             | 160                | 0.008                           | 0.008                            |
| 2001-005      | R0.05                    | 0.5                   | 43,600                             | 160                | 0.007                           | 0.007                            | 32,700                             | 110                | 0.005                           | 0.005                            |
| 2002-005      | R0.1                     | 0.5                   | 43,600                             | 550                | 0.025                           | 0.05                             | 32,700                             | 380                | 0.02                            | 0.04                             |
| 2002-010      | R0.1                     | 1                     | 43,600                             | 440                | 0.02                            | 0.04                             | 32,700                             | 270                | 0.015                           | 0.03                             |
| 2002-015      | R0.1                     | 1.5                   | 32,900                             | 250                | 0.015                           | 0.03                             | 24,700                             | 120                | 0.008                           | 0.02                             |
| 2003-010      | R0.15                    | 1                     | 43,600                             | 760                | 0.03                            | 0.07                             | 32,700                             | 550                | 0.03                            | 0.07                             |
| 2003-020      | R0.15                    | 2                     | 39,200                             | 390                | 0.02                            | 0.03                             | 29,400                             | 200                | 0.01                            | 0.02                             |
| 2004-010      | R0.2                     | 1                     | 43,600                             | 1,090              | 0.05                            | 0.1                              | 32,700                             | 760                | 0.04                            | 0.08                             |
| 2004-020      | R0.2                     | 2                     | 43,600                             | 650                | 0.035                           | 0.06                             | 32,700                             | 380                | 0.02                            | 0.05                             |
| 2004-030      | R0.2                     | 3                     | 35,000                             | 470                | 0.02                            | 0.04                             | 29,200                             | 230                | 0.01                            | 0.03                             |
| 2004-040      | R0.2                     | 4                     | 27,300                             | 270                | 0.008                           | 0.015                            | 19,600                             | 110                | 0.005                           | 0.01                             |
| 2005-020      | R0.25                    | 2                     | 43,600                             | 870                | 0.08                            | 0.15                             | 32,700                             | 550                | 0.08                            | 0.15                             |
| 2005-030      | R0.25                    | 3                     | 38,200                             | 650                | 0.06                            | 0.1                              | 29,500                             | 390                | 0.06                            | 0.08                             |
| 2005-040      | R0.25                    | 4                     | 32,700                             | 440                | 0.04                            | 0.08                             | 24,000                             | 220                | 0.025                           | 0.05                             |
| 2006-020      | R0.3                     | 2                     | 43,600                             | 1,750              | 0.12                            | 0.2                              | 32,700                             | 1,310              | 0.12                            | 0.2                              |
| 2006-030      | R0.3                     | 3                     | 43,600                             | 1,090              | 0.1                             | 0.14                             | 32,700                             | 760                | 0.08                            | 0.1                              |
| 2006-040      | R0.3                     | 4                     | 32,700                             | 760                | 0.07                            | 0.1                              | 27,300                             | 440                | 0.04                            | 0.06                             |
| 2006-050      | R0.3                     | 5                     | 29,500                             | 650                | 0.05                            | 0.08                             | 24,000                             | 330                | 0.02                            | 0.04                             |
| 2006-060      | R0.3                     | 6                     | 27,300                             | 550                | 0.04                            | 0.06                             | 21,800                             | 220                | 0.01                            | 0.03                             |
| 2008-030      | R0.4                     | 3                     | 43,600                             | 2,180              | 0.15                            | 0.3                              | 32,700                             | 1,530              | 0.15                            | 0.3                              |
| 2008-040      | R0.4                     | 4                     | 38,200                             | 1,750              | 0.12                            | 0.2                              | 29,500                             | 1,090              | 0.1                             | 0.16                             |
| 2008-060      | R0.4                     | 6                     | 32,700                             | 1,090              | 0.08                            | 0.15                             | 21,800                             | 550                | 0.05                            | 0.1                              |
| 2010-020      | R0.5                     | 2                     | 39,100                             | 2,740              | 0.25                            | 0.4                              | 30,000                             | 2,050              | 0.25                            | 0.4                              |
| 2010-030      | R0.5                     | 3                     | 39,100                             | 2,740              | 0.25                            | 0.4                              | 30,000                             | 1,960              | 0.25                            | 0.4                              |
| 2010-040      | R0.5                     | 4                     | 39,100                             | 2,350              | 0.2                             | 0.4                              | 29,500                             | 1,560              | 0.2                             | 0.4                              |
| 2010-060      | R0.5                     | 6                     | 34,500                             | 1,840              | 0.14                            | 0.3                              | 26,200                             | 1,150              | 0.1                             | 0.25                             |
| 2010-080      | R0.5                     | 8                     | 27,300                             | 1,090              | 0.12                            | 0.2                              | 19,600                             | 550                | 0.06                            | 0.1                              |
| 2015-040      | R0.75                    | 4                     | 25,500                             | 2,270              | 0.3                             | 0.6                              | 21,300                             | 1,700              | 0.3                             | 0.6                              |
| 2015-060      | R0.75                    | 6                     | 25,500                             | 2,040              | 0.3                             | 0.6                              | 21,300                             | 1,530              | 0.3                             | 0.6                              |
| 2020-040      | R1                       | 4                     | 18,700                             | 2,490              | 0.45                            | 0.8                              | 14,000                             | 1,500              | 0.45                            | 0.8                              |
| 2020-060      | R1                       | 6                     | 18,700                             | 2,080              | 0.45                            | 0.8                              | 14,000                             | 1,250              | 0.45                            | 0.8                              |
| 2020-080      | R1                       | 8                     | 18,700                             | 1,800              | 0.4                             | 0.8                              | 13,500                             | 1,200              | 0.4                             | 0.8                              |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

**Note:**

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when chattering occurs.
- Recommend wet coolant for Copper, Aluminum alloy and Tungsten-Copper.



# Milling Example of Copper Electrode Model (Tough Pitch Copper)

## R1 x Effective length 8mm

### The comparison example of VDLCLB( $\phi 3$ shank) and DLCLB( $\phi 4$ shank)

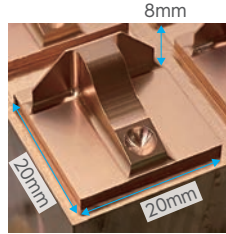
#### Comparison of tool wearing

<Condition>

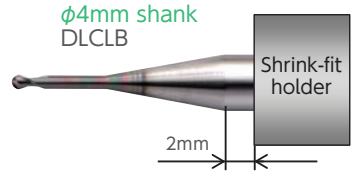
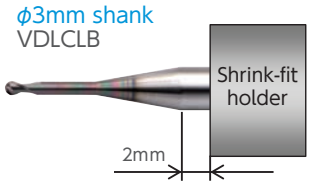
Work material : Tough Pitch Copper  
 Coolant : Oil mist  
 Milling shape : □20 mm x 20 mm x height 8 mm

<Tool>\*1

VDLCLB 2020-080 ( $\phi 3$  shank)  
 DLCLB 2020-080 ( $\phi 4$  shank)  
 \*1 1 for roughing to semi-finishing, 1 for finishing  
 total 2 ea.  
 \*2 Both models are set so that the overhang of shank is 2 mm.



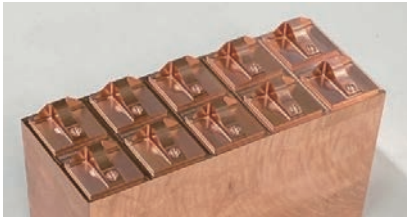
Milling shape



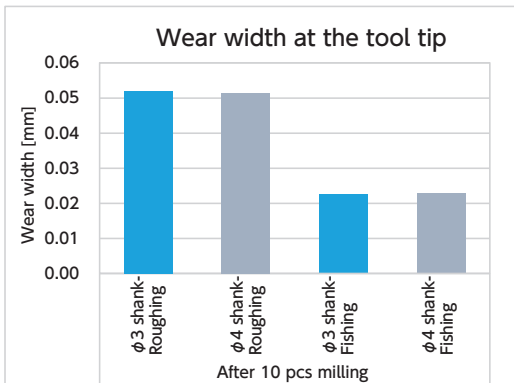
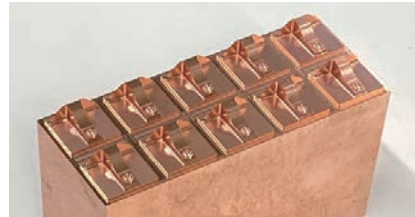
VDLCLB  
Milling Video

| No.   | Milling Process | Spindle speed (min <sup>-1</sup> ) | Feed rate (mm/min) | ap (mm) | ae (mm) | Allowance (mm) | Cycle time/ 1 pc    |
|-------|-----------------|------------------------------------|--------------------|---------|---------|----------------|---------------------|
| 1     | Roughing        | 18,700                             | 1,800              | 0.4     | 0.8     | 0.08           | 14 min. 6 sec.      |
| 2     | Semi-finishing  | 18,700                             | 1,800              | 0.05    | 0.05    | 0.03           | 1 h 17 min. 24 sec. |
| 3     | Finishing       | 18,700/<br>30,000(Bottom)          | 900                | 0.03    | 0.03    | 0              | 1 h 17 min. 0 sec.  |
| Total |                 |                                    |                    |         |         |                | 2 h 48 min. 30 sec. |

VDLCLB( $\phi 3$  shank)  
Milling application



DLCLB( $\phi 4$  shank)  
Milling application



[Tool after 10pcs milling ]

VDLCLB  
( $\phi 3$  shank)

DLCLB  
( $\phi 4$  shank)

Roughing to  
Semi-finishing

Cycle time:  
15 h 15 min



Finishing

Cycle time:  
12 h 50 min.



No difference of tool wearing with regard to the shank diameter gap.

## Comparison of dimensional accuracy and roughness

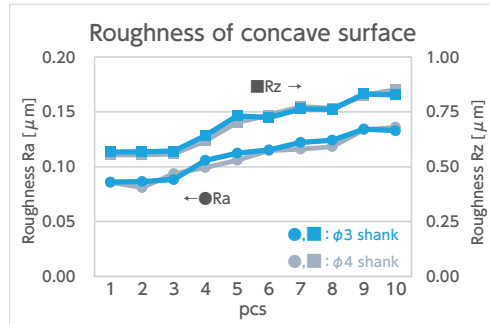
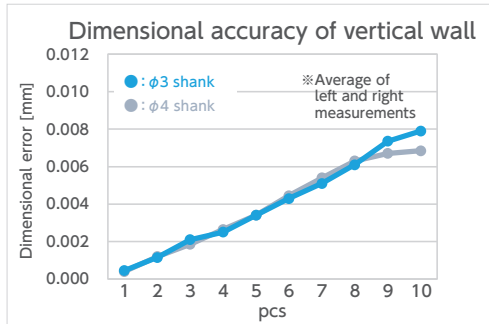
Measuring for dimensional accuracy of vertical wall and roughness of concave surface.

Measuring position for dimensional accuracy (Left)

Measuring position for roughness



Measuring position for dimensional accuracy (Right)



Both the dimensional accuracy and roughness gave very similar results, with no difference with regard to the shank diameter gap.

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

# VHLS

Value Series HARDMAX Longneck Square

## HARDMAX 2 Flutes Short Shank Long Neck Square End Mills

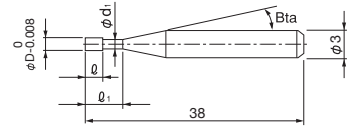
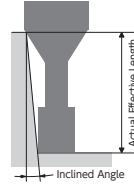
NEW

Super  
MG

HARD  
MAX



Shank Dia  
0/-0.003



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

### Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| CARBON STEELS S45C S55C | ALLOY STEELS SK / SCM SUS | PREHARDENED STEELS NAK HPM | HARDENED STEELS |        |        |        |        | CAST IRON | ALUMINUM ALLOYS | GRAPHITE | COPPER | PLASTICS | GLASS FILLED PLASTICS | TITANIUM ALLOYS | HEAT RESISTANT ALLOYS | CEMENTED CARBIDE | HARD BRITTLE (NON-METALLIC) MATERIALS |
|-------------------------|---------------------------|----------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
|                         |                           |                            | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                       | ○                         | ●                          | ●               | ●      | ○      |        | ○      |           |                 | ○        |        |          | ○                     | ○               |                       |                  |                                       |

### Total 30 models

Unit (mm)

| Model Number  | Outside Diameter $\phi$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $B\alpha$ | Effective Length by Inclined Angles |      |        |      |      | Suggested Retail Price ¥ |
|---------------|-------------------------|---------------------------|----------------------|--------------------------|-----------------------------|-------------------------------------|------|--------|------|------|--------------------------|
|               |                         |                           |                      |                          |                             | 30°                                 | 1°   | 1° 30' | 2°   | 3°   |                          |
| VHLS 2001-003 | 0.1                     | 0.3                       | 0.1                  | 0.093                    | 11°                         | 0.35                                | 0.37 | 0.39   | 0.42 | 0.48 | 5,580                    |
| VHLS 2002-005 | 0.2                     | 0.5                       | 0.3                  | 0.18                     | 16°                         | 0.68                                | 0.72 | 0.76   | 0.80 | 0.87 | 3,660                    |
| VHLS 2002-010 | 0.2                     | 1                         | 0.3                  | 0.18                     | 16°                         | 1.21                                | 1.27 | 1.32   | 1.37 | 1.48 | 3,960                    |
| VHLS 2003-010 | 0.3                     | 1                         | 0.4                  | 0.28                     | 16°                         | 1.25                                | 1.32 | 1.39   | 1.45 | 1.56 | 3,240                    |
| VHLS 2003-015 | 0.3                     | 1.5                       | 0.4                  | 0.28                     | 16°                         | 1.77                                | 1.86 | 1.94   | 2.02 | 2.17 | 3,240                    |
| VHLS 2003-020 | 0.3                     | 2                         | 0.4                  | 0.28                     | 16°                         | 2.30                                | 2.41 | 2.50   | 2.59 | 2.78 | 3,960                    |
| VHLS 2004-015 | 0.4                     | 1.5                       | 0.6                  | 0.38                     | 16°                         | 1.85                                | 1.97 | 2.07   | 2.17 | 2.34 | 2,340                    |
| VHLS 2004-020 | 0.4                     | 2                         | 0.6                  | 0.38                     | 16°                         | 2.38                                | 2.52 | 2.64   | 2.75 | 2.96 | 2,340                    |
| VHLS 2004-030 | 0.4                     | 3                         | 0.6                  | 0.38                     | 16°                         | 3.44                                | 3.61 | 3.75   | 3.88 | 4.18 | 2,340                    |
| VHLS 2004-040 | 0.4                     | 4                         | 0.6                  | 0.38                     | 16°                         | 4.49                                | 4.69 | 4.85   | 5.02 | 5.40 | 2,340                    |
| VHLS 2005-015 | 0.5                     | 1.5                       | 0.7                  | 0.49                     | 16°                         | 1.92                                | 2.06 | 2.19   | 2.30 | 2.51 | 1,800                    |
| VHLS 2005-020 | 0.5                     | 2                         | 0.7                  | 0.49                     | 16°                         | 2.46                                | 2.62 | 2.76   | 2.89 | 3.13 | 1,800                    |
| VHLS 2005-025 | 0.5                     | 2.5                       | 0.7                  | 0.49                     | 16°                         | 2.99                                | 3.18 | 3.33   | 3.47 | 3.74 | 1,800                    |
| VHLS 2005-030 | 0.5                     | 3                         | 0.7                  | 0.49                     | 16°                         | 3.52                                | 3.73 | 3.89   | 4.04 | 4.35 | 1,800                    |
| VHLS 2005-040 | 0.5                     | 4                         | 0.7                  | 0.49                     | 16°                         | 4.58                                | 4.82 | 5.01   | 5.18 | 5.57 | 1,800                    |
| VHLS 2005-060 | 0.5                     | 6                         | 0.7                  | 0.49                     | 16°                         | 6.69                                | 6.97 | 7.21   | 7.46 | 8.02 | 1,800                    |
| VHLS 2006-020 | 0.6                     | 2                         | 0.9                  | 0.59                     | 16°                         | 2.52                                | 2.71 | 2.88   | 3.03 | 3.30 | 1,800                    |
| VHLS 2006-030 | 0.6                     | 3                         | 0.9                  | 0.59                     | 16°                         | 3.60                                | 3.83 | 4.02   | 4.20 | 4.52 | 1,800                    |
| VHLS 2006-040 | 0.6                     | 4                         | 0.9                  | 0.59                     | 16°                         | 4.67                                | 4.93 | 5.15   | 5.34 | 5.75 | 1,800                    |
| VHLS 2006-060 | 0.6                     | 6                         | 0.9                  | 0.59                     | 16°                         | 6.78                                | 7.10 | 7.36   | 7.62 | 8.19 | 1,800                    |
| VHLS 2008-030 | 0.8                     | 3                         | 1.2                  | 0.79                     | 16°                         | 3.60                                | 3.83 | 4.02   | 4.20 | 4.52 | 1,980                    |
| VHLS 2008-040 | 0.8                     | 4                         | 1.2                  | 0.79                     | 16°                         | 4.67                                | 4.93 | 5.15   | 5.34 | 5.75 | 1,980                    |
| VHLS 2008-060 | 0.8                     | 6                         | 1.2                  | 0.79                     | 16°                         | 6.78                                | 7.10 | 7.36   | 7.62 | 8.19 | 1,980                    |
| VHLS 2010-030 | 1                       | 3                         | 1.5                  | 0.96                     | 16°                         | 3.71                                | 3.92 | 4.10   | 4.26 | 4.59 | 1,800                    |
| VHLS 2010-040 | 1                       | 4                         | 1.5                  | 0.96                     | 16°                         | 4.77                                | 5.01 | 5.22   | 5.40 | 5.81 | 1,800                    |
| VHLS 2010-050 | 1                       | 5                         | 1.5                  | 0.96                     | 16°                         | 5.82                                | 6.09 | 6.32   | 6.54 | 7.03 | 1,800                    |
| VHLS 2010-060 | 1                       | 6                         | 1.5                  | 0.96                     | 16°                         | 6.87                                | 7.17 | 7.42   | 7.68 | 8.26 | 1,800                    |
| VHLS 2015-040 | 1.5                     | 4                         | 2.3                  | 1.46                     | 16°                         | 4.17                                | 4.31 | 4.46   | 4.61 | 4.96 | 1,920                    |
| VHLS 2015-060 | 1.5                     | 6                         | 2.3                  | 1.46                     | 16°                         | 6.24                                | 6.44 | 6.66   | 6.89 | 7.41 | 1,920                    |
| VHLS 2020-060 | 2                       | 6                         | 3                    | 1.93                     | 16°                         | 6.29                                | 6.49 | 6.71   | 6.95 | 7.47 | 1,920                    |



# VHLS Milling Conditions

| WORK MATERIAL |                       |                       | COPPER<br>OFC / TPC                |                    |                                 |                                  | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001-003      | 0.1                   | 0.3                   | 50,000                             | 170                | 0.018                           | 0.035                            | 50,000                                   | 170                | 0.005                           | 0.035                            | 50,000  | 160                | 0.005                           | 0.035                            |
| 2002-005      | 0.2                   | 0.5                   | 50,000                             | 340                | 0.027                           | 0.13                             | 50,000                                   | 340                | 0.009                           | 0.13                             | 50,000  | 310                | 0.008                           | 0.13                             |
| 2002-010      | 0.2                   | 1                     | 50,000                             | 290                | 0.018                           | 0.035                            | 50,000                                   | 290                | 0.007                           | 0.035                            | 50,000  | 260                | 0.006                           | 0.035                            |
| 2003-010      | 0.3                   | 1                     | 50,000                             | 560                | 0.045                           | 0.101                            | 50,000                                   | 560                | 0.015                           | 0.101                            | 50,000  | 500                | 0.013                           | 0.101                            |
| 2003-015      | 0.3                   | 1.5                   | 50,000                             | 460                | 0.041                           | 0.05                             | 50,000                                   | 460                | 0.013                           | 0.05                             | 50,000  | 410                | 0.011                           | 0.05                             |
| 2003-020      | 0.3                   | 2                     | 41,500                             | 350                | 0.032                           | 0.023                            | 41,500                                   | 350                | 0.01                            | 0.023                            | 41,500  | 320                | 0.009                           | 0.023                            |
| 2004-015      | 0.4                   | 1.5                   | 50,000                             | 660                | 0.054                           | 0.095                            | 50,000                                   | 660                | 0.016                           | 0.095                            | 50,000  | 640                | 0.015                           | 0.095                            |
| 2004-020      | 0.4                   | 2                     | 50,000                             | 610                | 0.045                           | 0.052                            | 50,000                                   | 610                | 0.014                           | 0.052                            | 50,000  | 580                | 0.013                           | 0.052                            |
| 2004-030      | 0.4                   | 3                     | 44,500                             | 510                | 0.027                           | 0.018                            | 44,500                                   | 510                | 0.009                           | 0.018                            | 43,600  | 450                | 0.008                           | 0.018                            |
| 2004-040      | 0.4                   | 4                     | 41,000                             | 440                | 0.018                           | 0.008                            | 41,000                                   | 440                | 0.006                           | 0.008                            | 38,000  | 360                | 0.005                           | 0.008                            |
| 2005-015      | 0.5                   | 1.5                   | 50,000                             | 1,020              | 0.09                            | 0.139                            | 50,000                                   | 1,020              | 0.029                           | 0.139                            | 50,000  | 870                | 0.027                           | 0.139                            |
| 2005-020      | 0.5                   | 2                     | 50,000                             | 900                | 0.081                           | 0.098                            | 50,000                                   | 900                | 0.025                           | 0.098                            | 50,000  | 760                | 0.023                           | 0.098                            |
| 2005-025      | 0.5                   | 2.5                   | 50,000                             | 780                | 0.072                           | 0.057                            | 50,000                                   | 780                | 0.021                           | 0.057                            | 47,000  | 650                | 0.019                           | 0.057                            |
| 2005-030      | 0.5                   | 3                     | 44,200                             | 660                | 0.05                            | 0.037                            | 44,200                                   | 660                | 0.016                           | 0.037                            | 39,900  | 530                | 0.015                           | 0.037                            |
| 2005-040      | 0.5                   | 4                     | 40,600                             | 580                | 0.041                           | 0.016                            | 40,600                                   | 580                | 0.013                           | 0.016                            | 36,100  | 460                | 0.012                           | 0.016                            |
| 2005-060      | 0.5                   | 6                     | 33,400                             | 420                | 0.023                           | 0.005                            | 33,400                                   | 420                | 0.007                           | 0.005                            | 28,500  | 320                | 0.006                           | 0.005                            |
| 2006-020      | 0.6                   | 2                     | 50,000                             | 1,240              | 0.117                           | 0.18                             | 50,000                                   | 1,240              | 0.038                           | 0.18                             | 50,000  | 930                | 0.034                           | 0.18                             |
| 2006-030      | 0.6                   | 3                     | 50,000                             | 990                | 0.09                            | 0.075                            | 50,000                                   | 990                | 0.03                            | 0.075                            | 44,000  | 740                | 0.026                           | 0.075                            |
| 2006-040      | 0.6                   | 4                     | 41,300                             | 740                | 0.063                           | 0.03                             | 41,300                                   | 740                | 0.021                           | 0.03                             | 34,700  | 550                | 0.018                           | 0.03                             |
| 2006-060      | 0.6                   | 6                     | 32,100                             | 520                | 0.036                           | 0.01                             | 32,100                                   | 520                | 0.012                           | 0.01                             | 27,000  | 390                | 0.01                            | 0.01                             |
| 2008-030      | 0.8                   | 3                     | 41,200                             | 1,050              | 0.171                           | 0.15                             | 41,200                                   | 1,050              | 0.053                           | 0.15                             | 34,500  | 790                | 0.049                           | 0.15                             |
| 2008-040      | 0.8                   | 4                     | 37,100                             | 930                | 0.14                            | 0.08                             | 37,100                                   | 930                | 0.044                           | 0.08                             | 31,100  | 700                | 0.04                            | 0.08                             |
| 2008-060      | 0.8                   | 6                     | 28,800                             | 680                | 0.077                           | 0.024                            | 28,800                                   | 680                | 0.025                           | 0.024                            | 24,200  | 510                | 0.022                           | 0.024                            |
| 2010-030      | 1                     | 3                     | 37,900                             | 1,340              | 0.257                           | 0.263                            | 37,900                                   | 1,340              | 0.067                           | 0.263                            | 31,500  | 990                | 0.072                           | 0.263                            |
| 2010-040      | 1                     | 4                     | 34,100                             | 1,170              | 0.212                           | 0.195                            | 34,100                                   | 1,170              | 0.067                           | 0.195                            | 28,400  | 870                | 0.06                            | 0.195                            |
| 2010-050      | 1                     | 5                     | 30,300                             | 1,000              | 0.167                           | 0.127                            | 30,300                                   | 1,000              | 0.053                           | 0.127                            | 25,300  | 750                | 0.048                           | 0.127                            |
| 2010-060      | 1                     | 6                     | 26,500                             | 850                | 0.122                           | 0.058                            | 26,500                                   | 850                | 0.039                           | 0.058                            | 22,100  | 630                | 0.035                           | 0.058                            |
| 2015-040      | 1.5                   | 4                     | 26,600                             | 1,340              | 0.378                           | 0.462                            | 26,600                                   | 1,340              | 0.12                            | 0.462                            | 22,100  | 1,000              | 0.109                           | 0.462                            |
| 2015-060      | 1.5                   | 6                     | 22,800                             | 1,120              | 0.297                           | 0.293                            | 22,800                                   | 1,120              | 0.094                           | 0.293                            | 19,000  | 840                | 0.085                           | 0.293                            |
| 2020-060      | 2                     | 6                     | 20,300                             | 1,350              | 0.338                           | 0.926                            | 20,300                                   | 1,350              | 0.107                           | 0.926                            | 17,400  | 1,030              | 0.097                           | 0.926                            |

2 Flutes

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Long Neck Square
- Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball
  - Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
  - Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

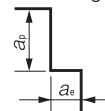
# VHLS Milling Conditions

| WORK MATERIAL |                       |                       | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKH<br>(55~60HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001-003      | 0.1                   | 0.3                   | 50,000  | 140                | 0.004                           | 0.035                            | 50,000                                     | 90                 | 0.002                           | 0.035                            | 30,000                                     | 10                 | 0.002                           | 0.08                             |
| 2002-005      | 0.2                   | 0.5                   | 50,000  | 270                | 0.006                           | 0.13                             | 44,800                                     | 180                | 0.004                           | 0.13                             | 15,000                                     | 10                 | 0.002                           | 0.13                             |
| 2002-010      | 0.2                   | 1                     | 50,000  | 230                | 0.004                           | 0.035                            | 40,800                                     | 160                | 0.002                           | 0.035                            | 15,000                                     | 10                 | 0.002                           | 0.035                            |
| 2003-010      | 0.3                   | 1                     | 50,000  | 440                | 0.01                            | 0.101                            | 50,000                                     | 330                | 0.007                           | 0.101                            | 14,600                                     | 14                 | 0.004                           | 0.101                            |
| 2003-015      | 0.3                   | 1.5                   | 50,000  | 360                | 0.009                           | 0.05                             | 42,700                                     | 260                | 0.006                           | 0.05                             | 14,600                                     | 13                 | 0.004                           | 0.05                             |
| 2003-020      | 0.3                   | 2                     | 41,500  | 280                | 0.007                           | 0.023                            | 33,200                                     | 190                | 0.005                           | 0.023                            | 14,600                                     | 12                 | 0.003                           | 0.023                            |
| 2004-015      | 0.4                   | 1.5                   | 48,100  | 470                | 0.012                           | 0.095                            | 38,500                                     | 320                | 0.008                           | 0.095                            | 14,300                                     | 17                 | 0.004                           | 0.095                            |
| 2004-020      | 0.4                   | 2                     | 44,600  | 430                | 0.01                            | 0.052                            | 35,700                                     | 290                | 0.007                           | 0.052                            | 14,300                                     | 17                 | 0.004                           | 0.052                            |
| 2004-030      | 0.4                   | 3                     | 37,500  | 340                | 0.006                           | 0.018                            | 30,000                                     | 230                | 0.005                           | 0.018                            | 14,300                                     | 16                 | 0.003                           | 0.018                            |
| 2004-040      | 0.4                   | 4                     | 33,100  | 280                | 0.004                           | 0.008                            | 26,500                                     | 190                | 0.003                           | 0.008                            | 14,300                                     | 15                 | 0.002                           | 0.008                            |
| 2005-015      | 0.5                   | 1.5                   | 46,500  | 610                | 0.02                            | 0.139                            | 37,300                                     | 410                | 0.015                           | 0.139                            | 14,000                                     | 20                 | 0.008                           | 0.139                            |
| 2005-020      | 0.5                   | 2                     | 40,600  | 510                | 0.018                           | 0.098                            | 32,500                                     | 350                | 0.013                           | 0.098                            | 14,000                                     | 20                 | 0.007                           | 0.098                            |
| 2005-025      | 0.5                   | 2.5                   | 34,700  | 410                | 0.016                           | 0.057                            | 27,700                                     | 290                | 0.011                           | 0.057                            | 14,000                                     | 20                 | 0.006                           | 0.057                            |
| 2005-030      | 0.5                   | 3                     | 32,200  | 370                | 0.011                           | 0.037                            | 25,700                                     | 260                | 0.009                           | 0.037                            | 14,000                                     | 19                 | 0.005                           | 0.037                            |
| 2005-040      | 0.5                   | 4                     | 29,700  | 330                | 0.009                           | 0.016                            | 23,700                                     | 230                | 0.007                           | 0.016                            | 14,000                                     | 18                 | 0.004                           | 0.016                            |
| 2005-060      | 0.5                   | 6                     | 24,700  | 250                | 0.005                           | 0.005                            | 19,700                                     | 170                | 0.003                           | 0.005                            | 14,000                                     | 16                 | 0.002                           | 0.005                            |
| 2006-020      | 0.6                   | 2                     | 39,100  | 600                | 0.026                           | 0.18                             | 31,300                                     | 410                | 0.019                           | 0.18                             | 12,000                                     | 23                 | 0.01                            | 0.18                             |
| 2006-030      | 0.6                   | 3                     | 33,500  | 500                | 0.02                            | 0.075                            | 26,800                                     | 340                | 0.015                           | 0.075                            | 12,000                                     | 22                 | 0.008                           | 0.075                            |
| 2006-040      | 0.6                   | 4                     | 27,900  | 390                | 0.014                           | 0.03                             | 22,300                                     | 270                | 0.01                            | 0.03                             | 12,000                                     | 21                 | 0.005                           | 0.03                             |
| 2006-060      | 0.6                   | 6                     | 23,000  | 290                | 0.008                           | 0.01                             | 18,400                                     | 200                | 0.006                           | 0.01                             | 12,000                                     | 19                 | 0.003                           | 0.01                             |
| 2008-030      | 0.8                   | 3                     | 26,200  | 530                | 0.038                           | 0.15                             | 21,000                                     | 370                | 0.027                           | 0.15                             | 8,000                                      | 21                 | 0.016                           | 0.15                             |
| 2008-040      | 0.8                   | 4                     | 24,100  | 480                | 0.031                           | 0.08                             | 19,300                                     | 330                | 0.022                           | 0.08                             | 8,000                                      | 20                 | 0.013                           | 0.08                             |
| 2008-060      | 0.8                   | 6                     | 19,800  | 370                | 0.017                           | 0.024                            | 15,800                                     | 250                | 0.012                           | 0.024                            | 8,000                                      | 18                 | 0.007                           | 0.024                            |
| 2010-030      | 1                     | 3                     | 23,400  | 650                | 0.057                           | 0.263                            | 18,700                                     | 440                | 0.039                           | 0.263                            | 6,500                                      | 15                 | 0.016                           | 0.263                            |
| 2010-040      | 1                     | 4                     | 21,500  | 580                | 0.047                           | 0.195                            | 17,200                                     | 400                | 0.033                           | 0.195                            | 6,500                                      | 15                 | 0.015                           | 0.195                            |
| 2010-050      | 1                     | 5                     | 19,600  | 510                | 0.037                           | 0.127                            | 15,700                                     | 360                | 0.027                           | 0.127                            | 6,500                                      | 15                 | 0.014                           | 0.127                            |
| 2010-060      | 1                     | 6                     | 17,600  | 440                | 0.027                           | 0.058                            | 14,100                                     | 310                | 0.02                            | 0.058                            | 6,500                                      | 14                 | 0.012                           | 0.058                            |
| 2015-040      | 1.5                   | 4                     | 16,300  | 640                | 0.084                           | 0.462                            | 13,000                                     | 440                | 0.06                            | 0.462                            | 9,600                                      | 95                 | 0.036                           | 0.462                            |
| 2015-060      | 1.5                   | 6                     | 14,400  | 550                | 0.066                           | 0.293                            | 11,500                                     | 380                | 0.047                           | 0.293                            | 9,600                                      | 60                 | 0.028                           | 0.293                            |
| 2020-060      | 2                     | 6                     | 12,500  | 650                | 0.075                           | 0.926                            | 10,000                                     | 450                | 0.054                           | 0.926                            | 9,600                                      | 211                | 0.032                           | 0.926                            |

**Note:**

- Recommend using a non-contact measuring device to avoid damaging the precision tip point.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Every coolant offers stable milling.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend wet coolant for Copper.

**Side Milling**



## HARDMAX 2 Flutes Short Shank Long Neck Radius End Mills

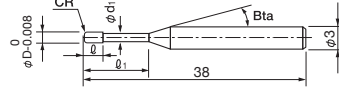
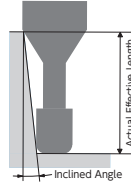
NEW

Super  
MG

HARD  
MAX



Shank Dia  
0/-0.003



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

### Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| CARBON STEELS<br>S45C<br>S55C | ALLOY STEELS<br>SK / SCM<br>SUS | PREHARDENED<br>STEELS<br>NAK<br>HPM | HARDENED STEELS |        |        |        |        | CAST IRON | ALUMINUM<br>ALLOYS | GRAPHITE | COPPER | PLASTICS | GLASS<br>FILLED<br>PLASTICS | TITANIUM<br>ALLOYS | HEAT<br>RESISTANT<br>ALLOYS | CEMENTED<br>CARBIDE | HARD BRITTLE<br>(NON-METALLIC)<br>MATERIALS |
|-------------------------------|---------------------------------|-------------------------------------|-----------------|--------|--------|--------|--------|-----------|--------------------|----------|--------|----------|-----------------------------|--------------------|-----------------------------|---------------------|---|
|                               |                                 |                                     | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                    |          |        |          |                             |                    |                             |                     |   |
| ○                             | ○                               | ●                                   | ●               | ●      | ●      | ○      | ○      |           |                    | ●        |        |          |                             | ○                  | ○                           |                     |   |

### Total 24 models

Unit (mm)

| Model Number       | Outside Diameter<br>$\phi$ | Corner Radius<br>CR | Effective Length<br>$\ell_1$ | Length of Cut<br>$\ell$ | Neck Diameter<br>$\phi_{d1}$ | Shank Taper Angle<br>Bta | Effective Length by Inclined Angles |      |        |      |      | Suggested Retail Price<br>¥ |
|--------------------|----------------------------|---------------------|------------------------------|-------------------------|------------------------------|--------------------------|-------------------------------------|------|--------|------|------|-----------------------------|
|                    |                            |                     |                              |                         |                              |                          | 30°                                 | 1°   | 1° 30' | 2°   | 3°   |                             |
| VHLRS 2002-005-010 | 0.2                        | 0.05                | 1                            | 0.2                     | 0.18                         | 16°                      | 1.21                                | 1.26 | 1.32   | 1.37 | 1.47 | 6,160                       |
| VHLRS 2003-005-010 | 0.3                        | 0.05                | 1                            | 0.3                     | 0.28                         | 16°                      | 1.25                                | 1.32 | 1.38   | 1.44 | 1.55 | 5,940                       |
| VHLRS 2004-005-020 | 0.4                        | 0.05                | 2                            | 0.4                     | 0.38                         | 16°                      | 2.38                                | 2.52 | 2.63   | 2.74 | 2.94 | 3,960                       |
| VHLRS 2004-01-020  | 0.4                        | 0.1                 | 2                            | 0.4                     | 0.38                         | 16°                      | 2.38                                | 2.51 | 2.63   | 2.73 | 2.93 | 3,960                       |
| VHLRS 2005-005-020 | 0.5                        | 0.05                | 2                            | 0.5                     | 0.49                         | 16°                      | 2.45                                | 2.62 | 2.76   | 2.88 | 3.12 | 3,220                       |
| VHLRS 2005-01-020  | 0.5                        | 0.1                 | 2                            | 0.5                     | 0.49                         | 16°                      | 2.45                                | 2.61 | 2.75   | 2.88 | 3.11 | 3,220                       |
| VHLRS 2006-005-020 | 0.6                        | 0.05                | 2                            | 0.6                     | 0.59                         | 16°                      | 2.52                                | 2.71 | 2.87   | 3.02 | 3.29 | 3,220                       |
| VHLRS 2006-005-030 | 0.6                        | 0.05                | 3                            | 0.6                     | 0.59                         | 16°                      | 3.59                                | 3.82 | 4.02   | 4.19 | 4.51 | 3,220                       |
| VHLRS 2006-005-040 | 0.6                        | 0.05                | 4                            | 0.6                     | 0.59                         | 16°                      | 4.66                                | 4.93 | 5.14   | 5.34 | 5.74 | 3,220                       |
| VHLRS 2006-01-020  | 0.6                        | 0.1                 | 2                            | 0.6                     | 0.59                         | 16°                      | 2.51                                | 2.70 | 2.86   | 3.01 | 3.28 | 3,220                       |
| VHLRS 2006-01-030  | 0.6                        | 0.1                 | 3                            | 0.6                     | 0.59                         | 16°                      | 3.59                                | 3.82 | 4.01   | 4.18 | 4.50 | 3,220                       |
| VHLRS 2006-01-040  | 0.6                        | 0.1                 | 4                            | 0.6                     | 0.59                         | 16°                      | 4.66                                | 4.92 | 5.14   | 5.33 | 5.72 | 3,220                       |
| VHLRS 2008-005-040 | 0.8                        | 0.05                | 4                            | 0.8                     | 0.79                         | 16°                      | 4.66                                | 4.93 | 5.14   | 5.34 | 5.74 | 3,670                       |
| VHLRS 2008-01-040  | 0.8                        | 0.1                 | 4                            | 0.8                     | 0.79                         | 16°                      | 4.66                                | 4.92 | 5.14   | 5.33 | 5.72 | 3,670                       |
| VHLRS 2008-02-040  | 0.8                        | 0.2                 | 4                            | 0.8                     | 0.79                         | 16°                      | 4.65                                | 4.91 | 5.13   | 5.32 | 5.70 | 3,670                       |
| VHLRS 2010-01-020  | 1                          | 0.1                 | 2                            | 1                       | 0.96                         | 16°                      | 2.64                                | 2.80 | 2.95   | 3.09 | 3.34 | 3,120                       |
| VHLRS 2010-01-040  | 1                          | 0.1                 | 4                            | 1                       | 0.96                         | 16°                      | 4.76                                | 5.00 | 5.20   | 5.39 | 5.79 | 3,120                       |
| VHLRS 2010-01-060  | 1                          | 0.1                 | 6                            | 1                       | 0.96                         | 16°                      | 6.87                                | 7.16 | 7.41   | 7.67 | 8.24 | 3,390                       |
| VHLRS 2010-02-020  | 1                          | 0.2                 | 2                            | 1                       | 0.96                         | 16°                      | 2.63                                | 2.79 | 2.94   | 3.07 | 3.32 | 3,120                       |
| VHLRS 2010-02-040  | 1                          | 0.2                 | 4                            | 1                       | 0.96                         | 16°                      | 4.76                                | 4.99 | 5.19   | 5.38 | 5.77 | 3,120                       |
| VHLRS 2010-02-060  | 1                          | 0.2                 | 6                            | 1                       | 0.96                         | 16°                      | 6.86                                | 7.15 | 7.40   | 7.65 | 8.21 | 3,390                       |
| VHLRS 2015-02-060  | 1.5                        | 0.2                 | 6                            | 1.5                     | 1.46                         | 16°                      | 6.23                                | 6.43 | 6.64   | 6.86 | 7.36 | 3,330                       |
| VHLRS 2020-01-060  | 2                          | 0.1                 | 6                            | 2                       | 1.93                         | 16°                      | 6.28                                | 6.49 | 6.70   | 6.93 | 7.45 | 3,330                       |
| VHLRS 2020-02-060  | 2                          | 0.2                 | 6                            | 2                       | 1.93                         | 16°                      | 6.28                                | 6.48 | 6.69   | 6.92 | 7.43 | 3,330                       |

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

# VHLRS Milling Conditions

| WORK MATERIAL |                       |                       | COPPER<br>OFC / TPC                |                    |                                 |                                  | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2002-005-010  | 0.2                   | 1                     | 55,000                             | 200                | 0.027                           | 0.02                             | 55,000                                   | 200                | 0.009                           | 0.02                             | 55,000  | 200                | 0.009                           | 0.02                             |
| 2003-005-010  | 0.3                   | 1                     | 60,000                             | 500                | 0.03                            | 0.02                             | 60,000                                   | 500                | 0.011                           | 0.02                             | 60,000  | 500                | 0.011                           | 0.02                             |
| 2004-005-020  | 0.4                   | 2                     | 40,400                             | 540                | 0.042                           | 0.054                            | 40,400                                   | 450                | 0.017                           | 0.045                            | 40,400  | 450                | 0.017                           | 0.045                            |
| 2004-01-020   | 0.4                   | 2                     | 40,400                             | 540                | 0.042                           | 0.054                            | 40,400                                   | 450                | 0.017                           | 0.045                            | 40,400  | 450                | 0.017                           | 0.045                            |
| 2005-005-020  | 0.5                   | 2                     | 39,900                             | 1,000              | 0.075                           | 0.108                            | 39,900                                   | 830                | 0.044                           | 0.117                            | 39,900  | 830                | 0.044                           | 0.117                            |
| 2005-01-020   | 0.5                   | 2                     | 39,900                             | 1,000              | 0.075                           | 0.108                            | 39,900                                   | 830                | 0.044                           | 0.117                            | 39,900  | 830                | 0.044                           | 0.117                            |
| 2006-005-020  | 0.6                   | 2                     | 28,600                             | 610                | 0.114                           | 0.162                            | 28,600                                   | 510                | 0.015                           | 0.219                            | 28,600  | 510                | 0.015                           | 0.219                            |
| 2006-005-030  | 0.6                   | 3                     | 23,800                             | 480                | 0.09                            | 0.135                            | 23,800                                   | 400                | 0.012                           | 0.108                            | 23,800  | 400                | 0.012                           | 0.108                            |
| 2006-005-040  | 0.6                   | 4                     | 20,400                             | 400                | 0.063                           | 0.108                            | 20,400                                   | 330                | 0.008                           | 0.104                            | 20,400  | 330                | 0.008                           | 0.104                            |
| 2006-01-020   | 0.6                   | 2                     | 28,600                             | 610                | 0.114                           | 0.162                            | 28,600                                   | 510                | 0.015                           | 0.219                            | 28,600  | 510                | 0.015                           | 0.219                            |
| 2006-01-030   | 0.6                   | 3                     | 23,800                             | 480                | 0.09                            | 0.135                            | 23,800                                   | 400                | 0.012                           | 0.108                            | 23,800  | 400                | 0.012                           | 0.108                            |
| 2006-01-040   | 0.6                   | 4                     | 20,400                             | 400                | 0.063                           | 0.108                            | 20,400                                   | 330                | 0.008                           | 0.104                            | 20,400  | 330                | 0.008                           | 0.104                            |
| 2008-005-040  | 0.8                   | 4                     | 17,500                             | 540                | 0.132                           | 0.198                            | 17,500                                   | 450                | 0.021                           | 0.117                            | 17,500  | 450                | 0.021                           | 0.117                            |
| 2008-01-040   | 0.8                   | 4                     | 17,500                             | 540                | 0.132                           | 0.198                            | 17,500                                   | 450                | 0.021                           | 0.117                            | 17,500  | 450                | 0.021                           | 0.117                            |
| 2008-02-040   | 0.8                   | 4                     | 17,500                             | 540                | 0.132                           | 0.198                            | 17,500                                   | 450                | 0.021                           | 0.117                            | 17,500  | 450                | 0.021                           | 0.117                            |
| 2010-01-020   | 1                     | 2                     | 17,600                             | 1,100              | 0.21                            | 0.45                             | 17,600                                   | 920                | 0.053                           | 0.27                             | 17,600  | 920                | 0.053                           | 0.27                             |
| 2010-01-040   | 1                     | 4                     | 13,800                             | 980                | 0.201                           | 0.405                            | 13,800                                   | 820                | 0.045                           | 0.27                             | 13,800  | 820                | 0.045                           | 0.27                             |
| 2010-01-060   | 1                     | 6                     | 11,300                             | 790                | 0.117                           | 0.387                            | 11,300                                   | 650                | 0.032                           | 0.216                            | 11,300  | 650                | 0.032                           | 0.216                            |
| 2010-02-020   | 1                     | 2                     | 17,600                             | 1,100              | 0.21                            | 0.45                             | 17,600                                   | 920                | 0.053                           | 0.27                             | 17,600  | 920                | 0.053                           | 0.27                             |
| 2010-02-040   | 1                     | 4                     | 13,800                             | 980                | 0.201                           | 0.405                            | 13,800                                   | 820                | 0.045                           | 0.27                             | 13,800  | 820                | 0.045                           | 0.27                             |
| 2010-02-060   | 1                     | 6                     | 11,300                             | 790                | 0.117                           | 0.387                            | 11,300                                   | 650                | 0.032                           | 0.216                            | 11,300  | 650                | 0.032                           | 0.216                            |
| 2015-02-060   | 1.5                   | 6                     | 10,600                             | 1,240              | 0.282                           | 0.63                             | 10,600                                   | 1,030              | 0.062                           | 0.405                            | 10,600  | 1,030              | 0.062                           | 0.405                            |
| 2020-01-060   | 2                     | 6                     | 12,800                             | 1,220              | 0.321                           | 0.855                            | 12,800                                   | 1,020              | 0.065                           | 0.81                             | 12,800  | 1,020              | 0.065                           | 0.81                             |
| 2020-02-060   | 2                     | 6                     | 12,800                             | 1,220              | 0.321                           | 0.855                            | 12,800                                   | 1,020              | 0.065                           | 0.81                             | 12,800  | 1,020              | 0.065                           | 0.81                             |

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius

Long Neck  
Radius  
Taper Neck  
Radius

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

# VHLRS Milling Conditions

| WORK MATERIAL |                       |                       | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKH<br>(55~65HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2002-005-010  | 0.2                   | 1                     | 55,000  | 200                | 0.006                           | 0.02                             | 35,000                                     | 150                | 0.004                           | 0.02                             | 15,000                                     | 25                 | 0.002                           | 0.015                            |
| 2003-005-010  | 0.3                   | 1                     | 60,000  | 500                | 0.007                           | 0.02                             | 35,000                                     | 350                | 0.005                           | 0.02                             | 22,000                                     | 35                 | 0.004                           | 0.015                            |
| 2004-005-020  | 0.4                   | 2                     | 40,400  | 450                | 0.011                           | 0.045                            | 32,300                                     | 330                | 0.009                           | 0.045                            | 19,200                                     | 35                 | 0.004                           | 0.045                            |
| 2004-01-020   | 0.4                   | 2                     | 40,400  | 450                | 0.011                           | 0.045                            | 32,300                                     | 330                | 0.009                           | 0.045                            | 19,200                                     | 35                 | 0.004                           | 0.045                            |
| 2005-005-020  | 0.5                   | 2                     | 39,900  | 830                | 0.029                           | 0.117                            | 32,500                                     | 630                | 0.026                           | 0.117                            | 20,100                                     | 68                 | 0.011                           | 0.117                            |
| 2005-01-020   | 0.5                   | 2                     | 39,900  | 830                | 0.029                           | 0.117                            | 32,500                                     | 630                | 0.026                           | 0.117                            | 20,100                                     | 68                 | 0.011                           | 0.117                            |
| 2006-005-020  | 0.6                   | 2                     | 28,600  | 510                | 0.01                            | 0.219                            | 23,700                                     | 390                | 0.01                            | 0.219                            | 15,200                                     | 43                 | 0.004                           | 0.219                            |
| 2006-005-030  | 0.6                   | 3                     | 23,800  | 400                | 0.008                           | 0.108                            | 19,700                                     | 300                | 0.007                           | 0.108                            | 12,600                                     | 33                 | 0.003                           | 0.108                            |
| 2006-005-040  | 0.6                   | 4                     | 20,400  | 330                | 0.005                           | 0.104                            | 16,800                                     | 250                | 0.005                           | 0.104                            | 10,800                                     | 28                 | 0.002                           | 0.104                            |
| 2006-01-020   | 0.6                   | 2                     | 28,600  | 510                | 0.01                            | 0.219                            | 23,700                                     | 390                | 0.01                            | 0.219                            | 15,200                                     | 43                 | 0.004                           | 0.219                            |
| 2006-01-030   | 0.6                   | 3                     | 23,800  | 400                | 0.008                           | 0.108                            | 19,700                                     | 300                | 0.007                           | 0.108                            | 12,600                                     | 33                 | 0.003                           | 0.108                            |
| 2006-01-040   | 0.6                   | 4                     | 20,400  | 330                | 0.005                           | 0.104                            | 16,800                                     | 250                | 0.005                           | 0.104                            | 10,800                                     | 28                 | 0.002                           | 0.104                            |
| 2008-005-040  | 0.8                   | 4                     | 17,500  | 450                | 0.014                           | 0.117                            | 15,000                                     | 360                | 0.015                           | 0.117                            | 10,200                                     | 41                 | 0.007                           | 0.117                            |
| 2008-01-040   | 0.8                   | 4                     | 17,500  | 450                | 0.014                           | 0.117                            | 15,000                                     | 360                | 0.015                           | 0.117                            | 10,200                                     | 41                 | 0.007                           | 0.117                            |
| 2008-02-040   | 0.8                   | 4                     | 17,500  | 450                | 0.014                           | 0.117                            | 15,000                                     | 360                | 0.015                           | 0.117                            | 10,200                                     | 41                 | 0.007                           | 0.117                            |
| 2010-01-020   | 1                     | 2                     | 17,600  | 920                | 0.035                           | 0.27                             | 15,300                                     | 750                | 0.04                            | 0.27                             | 10,900                                     | 89                 | 0.02                            | 0.27                             |
| 2010-01-040   | 1                     | 4                     | 13,800  | 820                | 0.03                            | 0.27                             | 12,000                                     | 670                | 0.035                           | 0.27                             | 8,500                                      | 80                 | 0.017                           | 0.27                             |
| 2010-01-060   | 1                     | 6                     | 11,300  | 650                | 0.021                           | 0.216                            | 9,800                                      | 540                | 0.024                           | 0.216                            | 7,000                                      | 64                 | 0.012                           | 0.216                            |
| 2010-02-020   | 1                     | 2                     | 17,600  | 920                | 0.035                           | 0.27                             | 15,300                                     | 750                | 0.04                            | 0.27                             | 10,900                                     | 89                 | 0.02                            | 0.27                             |
| 2010-02-040   | 1                     | 4                     | 13,800  | 820                | 0.03                            | 0.27                             | 12,000                                     | 670                | 0.035                           | 0.27                             | 8,500                                      | 80                 | 0.017                           | 0.27                             |
| 2010-02-060   | 1                     | 6                     | 11,300  | 650                | 0.021                           | 0.216                            | 9,800                                      | 540                | 0.024                           | 0.216                            | 7,000                                      | 64                 | 0.012                           | 0.216                            |
| 2015-02-060   | 1.5                   | 6                     | 10,600  | 1,030              | 0.041                           | 0.405                            | 9,700                                      | 900                | 0.055                           | 0.405                            | 7,400                                      | 117                | 0.03                            | 0.405                            |
| 2020-01-060   | 2                     | 6                     | 12,800  | 1,020              | 0.043                           | 0.81                             | 12,000                                     | 930                | 0.06                            | 0.81                             | 9,700                                      | 133                | 0.036                           | 0.81                             |
| 2020-02-060   | 2                     | 6                     | 12,800  | 1,020              | 0.043                           | 0.81                             | 12,000                                     | 930                | 0.06                            | 0.81                             | 9,700                                      | 133                | 0.036                           | 0.81                             |

2 Flutes

Ø3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

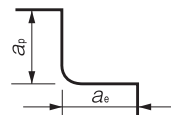
Spiral V Cutter

Drill

Technical Data

**Note:**

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Every coolant offers stable milling.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend wet coolant for Copper.





For Cemented Carbide and Hard Brittle Materials



*UDC Series*

*ULTRA DIAMOND COAT*



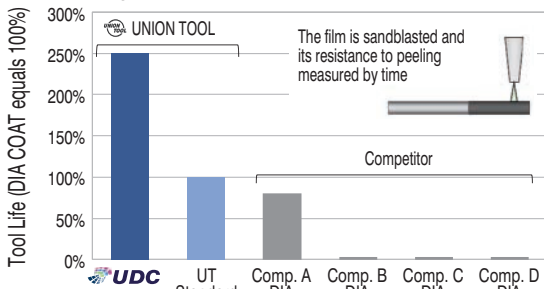
# Features of UDC series

## Optimized diamond coating for Cemented Carbide and Hard Brittle Materials

Coating Patented in Japan

Special high-performance Diamond film.  
New Diamond coating developed to improve hardness and durability, with outstanding adhesion to the cutting tool.

### Sandblasting tests the film adhesion and wear resistance



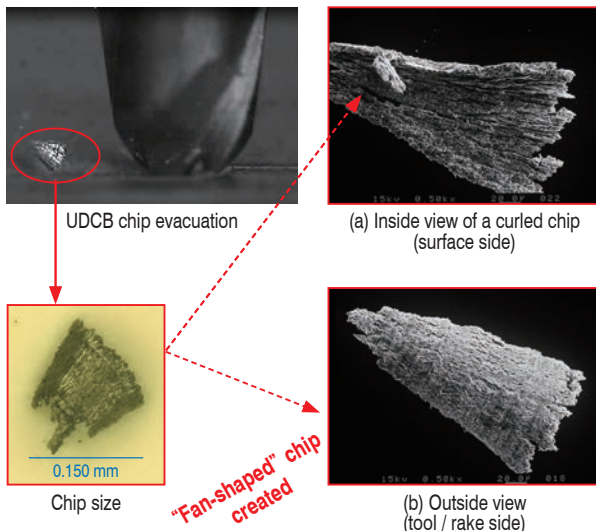
UNION TOOL's Diamond film that coated using the hot filament CVD method is developed to improve hardness and durability, with outstanding adhesion to the cutting tool. Using fine particle composition control, the UDC coating has dramatically improved hardness and durability.

## Direct Milling of Cemented Carbide - No Grinding!

The normal expectation when milling Cemented Carbide would be a powdered swarf...



By using a deep cut into the Cemented Carbide, UDCB creates a "fan shaped" chip, just like cutting steel!

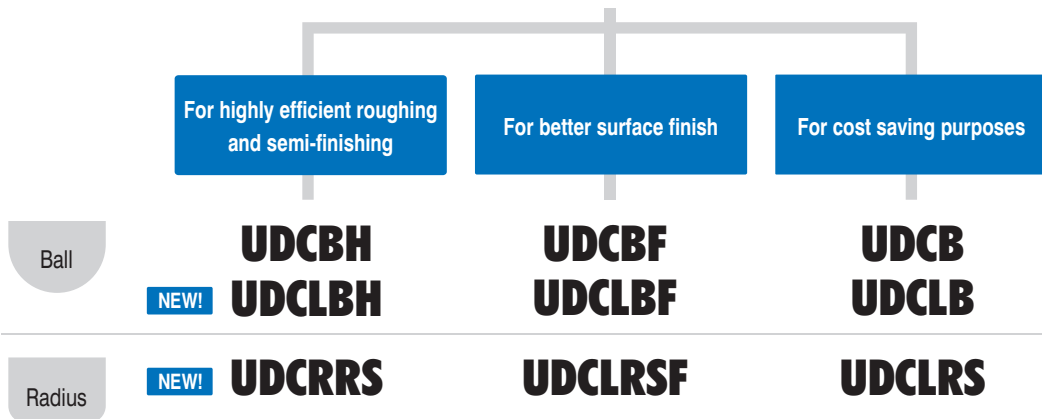


### UDCB R0.5 Ball End Mill

|               |                             |
|---------------|-----------------------------|
| Tool          | UDCB 2010-0070 (R0.5 × 0.7) |
| Spindle Speed | 30,000 min <sup>-1</sup>    |
| Feed Rate     | 300 mm/min                  |
| $a_p$         | 0.1 mm                      |
| Coolant       | Air Blow                    |
| Work Material | VM-40 (90HRA)               |



# Choose by application



The long-awaited 3rd generation UDC!

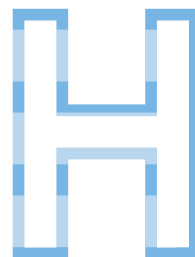
## UDC-H series

Patent pending

The best match for roughing and semi-finishing of cemented carbide.

### Features of H series

- High-level Treatment!!** → Unbelievable milling performance
- High Speed!!** → Mill at surprisingly high feed rate
- High Material Removal Volume!!** → Highly improved material removal volume



### Attain both high efficiency and long tool life!

The key points

New generation edge treatment minimizes tool damage



Improved diamond coating to enhance wear resistance



- ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

# UDCBH



**7.5 times**  
the efficiency

**Over 4 times**  
the removal volume

Work Size : 50 x 50 x 10 mm

Pocket Size : Top  $\phi$  10 x Depth 3.5 mm

Material Removal Volume : 160 mm<sup>3</sup> / Pocket

Coolant : Air Blow

UDCBH shows maximum tool performance under high-speed conditions.  
Tool life may shorten when used at the same feed rate as before.



UDCBH  
Milling example

| Tool                             | UDCBH   | UDCBF  |
|----------------------------------|---|--|
| Milling Conditions               |   |  |
| Spindle Speed                    | 30,000 min <sup>-1</sup>  | 20,000 min <sup>-1</sup>   |
| Feed Rate                        | <b>1,500</b> mm/min   | <b>200</b> mm/min  |
| $a_p$                            | 0.1 mm  |  |
| $a_e$                            | 0.3 mm  |  |
| Milling Results                  |   |  |
| 1 side<br>16 pockets             | <b>1 Tool</b> Milling time <b>76 min</b>  | 4 Tool Milling time 7 h 28 min   |
| Tool after milling<br>4 pockets  |  |  |
| Tool after milling<br>16 pockets |  |   |

**Still functional**

3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taber

Barrel

Spiral V Cutter

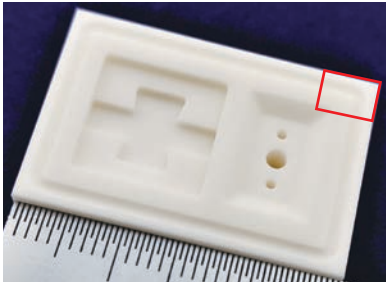
Drill

Technical Data

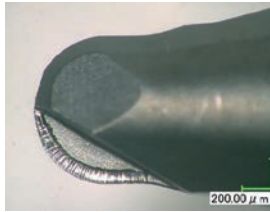
**Hard Brittle Materials Electronic component assembly jig shaped milling with UDCBH R0.5 x L0.7**

**Alumina Al<sub>2</sub>O<sub>3</sub> (99.5%)  
Zirconia ZrO<sub>2</sub> (94%)**

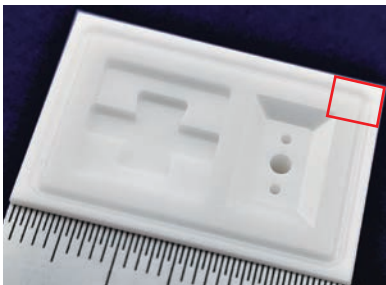
Alumina Al<sub>2</sub>O<sub>3</sub> (99.5%)



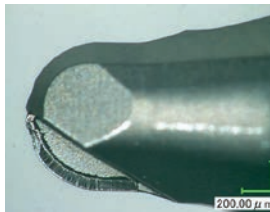
Work Size : 30 x 20 x 10 mm  
Coolant : Water Soluble



Zirconia ZrO<sub>2</sub> (94%)



Work Size : 30 x 20 x 10 mm  
Coolant : Water Soluble

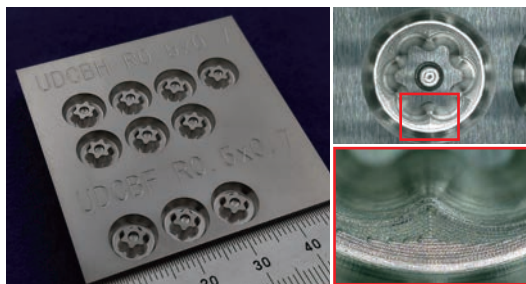


| No | Process                               | Tool  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Allowance (mm) | Cycle Time (h:m:s) |
|----|---------------------------------------|---|------------------------------------|--------------------|---------------------|---------------------|----------------|--------------------|
| 1  | Slotting and inclined pocket roughing | UDCBH 2010-0070 (R0.5 × L0.7)               | 30,000                             | 300                | 0.05                | 0.25                | 0.01/0.03      | 0:36:29            |
| 2  | Slot finishing                        |   |                                    |                    |                     |                     | 0              | 0:19:17            |
| 3  | 2-stage pocket roughing               | UDCLBF 2010-0200 (R0.5 × EL2)               | 30,000                             | 300                | 0.028               | 0.028               | 0.03           | 0:52:42            |
| 4  | Re-machining                          | UDCLRSF 2008-005024 (φ0.8 × CR0.05 × EL2.4) | 30,000                             | 175                | 0.023               | 0.5                 | 0.03           | 0:18:26            |
| 5  | Semi-finishing                        |   |                                    |                    | 0.02                | 0.25                | 0.01           | 0:51:09            |
| 6  | Finishing                             |   |                                    |                    | 0.014               | 0.25                | 0              | 1:12:32            |
| 7  | Drilling                              | UDCMX 2200-100 (φ2 × Flute Length 10)       | 2,400                              | 5                  | 0.15                | —                   | —              | 0:03:15            |
| 8  |                                       | UDCMX 2100-100 (φ1 × Flute Length 10)       | 5,000                              | 7.5                | 0.05                | —                   | —              | 0:10:44            |

Hole Depth 7 mm Total 4:24:34

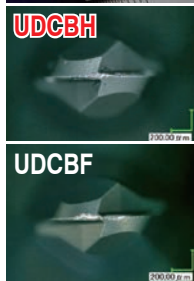
- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

**Cemented Carbide Hexalobular Comparison of efficiency and material removal volume with UDCBH / UDCBF R0.5 x L0.7 VM-40 (90 HRA)**



Model Size :  $\phi 9 \times 2.2 \text{ mm}$  91 mm<sup>3</sup> / pc  
Coolant : Air Blow

**Less than 1/3 of the cycle time**  
**More than twice the tool life of UDCBF**

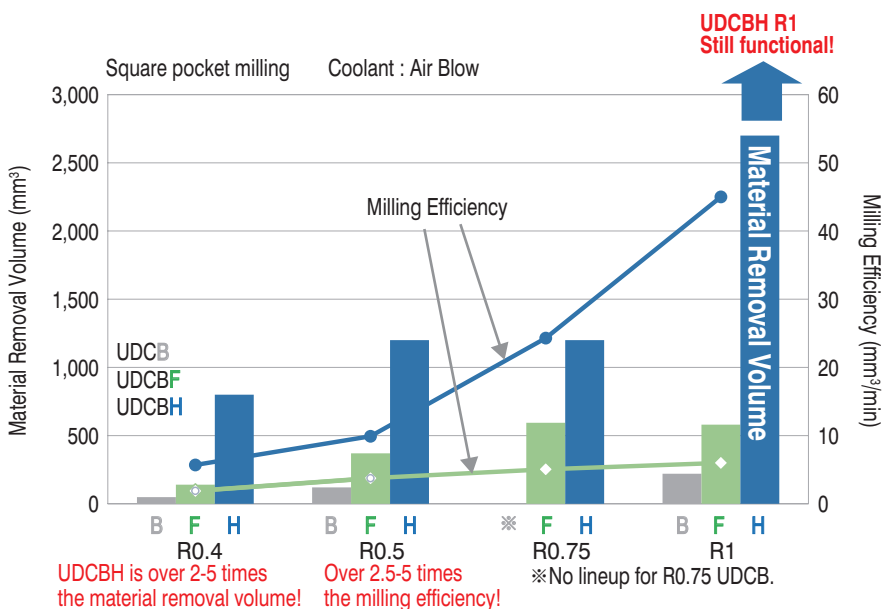


Tool damage at the time of machining 3 pieces

| Tool                            | UDCBF                    |                          | UDCBH                    |                          |
|---------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                                 | Hexalobular              | Character engraving      | Hexalobular              | Character engraving      |
| Model                           | Hexalobular              | Character engraving      | Hexalobular              | Character engraving      |
| Cycle Time / pc                 | 38 min 21 sec            | 1 min 56 sec             | 11 min 50 sec            | 38 sec                   |
| Number of processed pieces / pc | 3 pcs                    | —                        | 7 pcs                    | —                        |
| Material Removal Volume         | 273 mm <sup>3</sup>      | —                        | 637 mm <sup>3</sup>      | —                        |
| Spindle Speed                   | 30,000 min <sup>-1</sup> | 15,000 min <sup>-1</sup> | 30,000 min <sup>-1</sup> | 15,000 min <sup>-1</sup> |
| Feed Rate                       | 300 mm/min               | 150 mm/min               | 900 mm/min               | 450 mm/min               |
| Feed Rate 2                     | 30 mm/min                | 30 mm/min                | 300 mm/min               | 300 mm/min               |
| $a_p$                           | 0.05 mm                  | 0.05 mm                  | 0.05 mm                  | 0.05 mm                  |
| $a_e$                           | 0.25 mm                  | —                        | 0.25 mm                  | —                        |

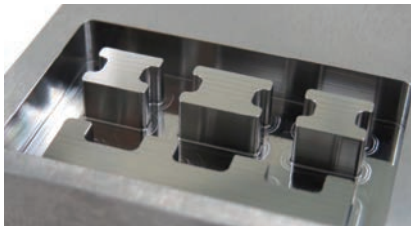
Efficiency  
3.2 times  
Tool life  
2.3 times

**Cemented Carbide Comparison of efficiency and material removal volume in roughing with UDCB / UDCBF / UDCBH VM-40 (90HRA)**



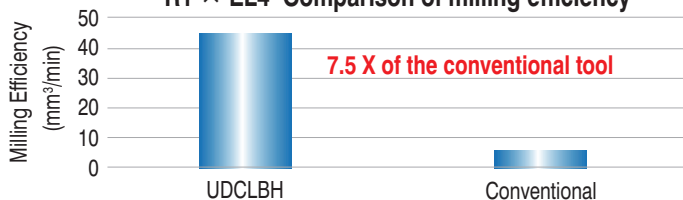
# Cemented Carbide Connector shaped milling with UDCLBH R1 x EL4

VM-40 (90HRA)



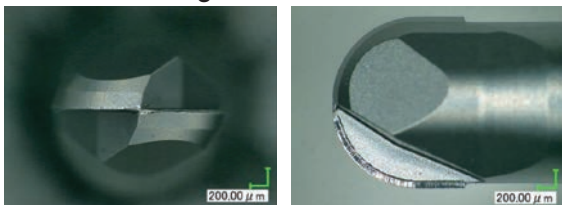
Model Size : 26 x 16 x 4 mm  
Pocket Volume : 1,304 mm<sup>3</sup>  
Coolant : Air Blow

## R1 × EL4 Comparison of milling efficiency



$$\text{Milling Efficiency} = \text{Feed Rate} \times a_p \times a_e$$

## Tool after milling



**Less tool damage even with highly efficient milling!**

| No | Process                                  | Tool No. | Tool                                     | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Allowance (mm) | Cycle Time (h:m:s) |
|----|--|----------|--|------------------------------------|--------------------|------------|------------|----------------|--------------------|
| 1  | Roughing                                 | T1       | UDCLBH 2020-0400 (R1 x EL4)              | 30,000                             | 1,500              | 0.1        | 0.3        | 0.03           | 0:24:52            |
| 2  | Corner Removal 1                         | T2       | UDCLBH 2010-0400 (R0.5 x EL4)            | 30,000                             | 400                | 0.05       | 0.11       | 0.03           | 0:33:12            |
| 3  | Corner Removal 2                         | T3       | UDCLRSF 2010-005040 (φ 1 x CR0.05 x EL4) | 30,000                             | 190                | 0.02       | 0.6        | 0.03           | 0:15:23            |
| 4  | Top surface / Semi-finishing             |          |  | 30,000                             | 190                | —          | 0.6        | 0.01           | 0:03:11            |
| 5  | Wall surface / Semi-finishing            | T2       | UDCLBH 2010-0400 (R0.5 x EL4)            | 30,000                             | 400                | 0.05       | 0.22       | 0.01           | 0:38:22            |
| 6  | Corner & Bottom surface / Semi-finishing | T3       | UDCLRSF 2010-005040 (φ 1 x CR0.05 x EL4) | 30,000                             | 190                | 0.006      | 0.3        | 0.01           | 0:48:30            |
| 7  | Top surface / Finishing                  | T4       | UDCLRSF 2010-005040 (φ 1 x CR0.05 x EL4) | 30,000                             | 190                | —          | 0.6        | 0              | 0:03:15            |
| 8  | Wall surface / Finishing                 |          |  | 30,000                             | 375                | 0.25       | —          | 0              | 0:08:17            |
| 9  | Corner & Bottom surface / Finishing      |          |  | 30,000                             | 190                | 0.014      | 0.3        | 0              | 0:46:09            |

Total 4pcs are used.

Total 3:41:11

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

The sharpest cutting edge in the UDC series

# UDC-F series

The best choice for high quality milling surface

## Features of F series

### ① UDC coating

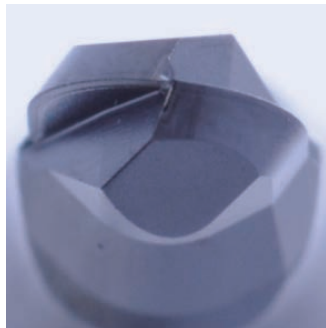
Optimized coating for F series

### ② Special treatment for a sharp edge

Minimized edge chipping and the level of the gap

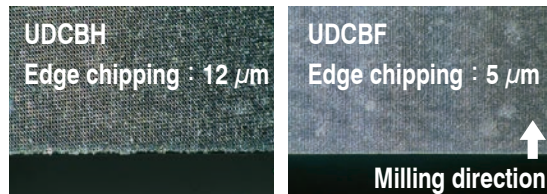
### ③ Chip pocket designed on tool tip

Excellent surface finish



Cemented Carbide Flat surface milling Comparison of edge chipping on work piece with UDCBH / UDCBF R0.4 × L0.56

VM-40 (90 HRA)



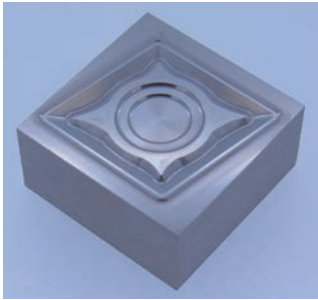
| Tool          | UDCBH                    | UDCBF      |
|---------------|--------------------------|------------|
| Spindle Speed | 30,000 min <sup>-1</sup> |            |
| Feed Rate     | 750 mm/min               | 250 mm/min |
| $a_p$         | 0.02 mm                  |            |
| $a_e$         | 0.02 mm                  |            |
| Coolant       | Air Blow                 |            |

**Improve efficiency and lower costs** by using the right tool to meet your edge chipping requirements.



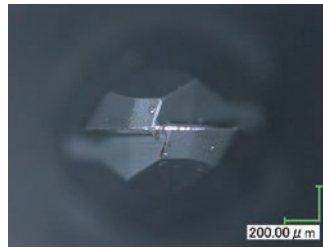
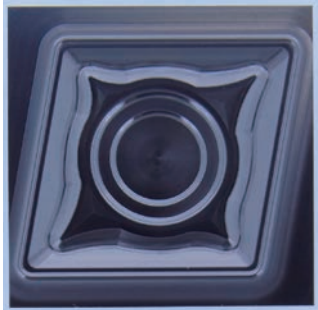
# Cemented Carbide Indexable insert mold milling with UDCBF R0.5 × L0.7

VM-40 (90 HRA)

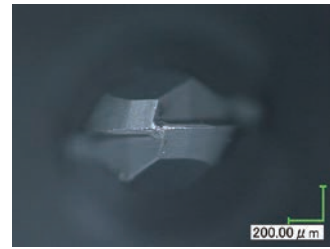


|                         | Roughing                     | Finishing            |
|-------------------------|------------------------------|----------------------|
| Tool                    | UDCBF 2010-0070 (R0.5 × 0.7) |                      |
| Spindle Speed           | 30,000 min <sup>-1</sup>     |                      |
| Feed Rate               | 300 mm/min                   |                      |
| a <sub>p</sub>          | 0.05 mm                      | 0.028 mm             |
| a <sub>e</sub>          | 0.25 mm                      | 0.02 mm              |
| Coolant                 | Air Blow                     |                      |
| Cycle Time              | 43 min                       | 2 h 17 min           |
| Material Removal Volume | 86.3 mm <sup>3</sup>         | 12.0 mm <sup>3</sup> |

※ One End Mill for both roughing and finishing processes. Total 2 tools are used.



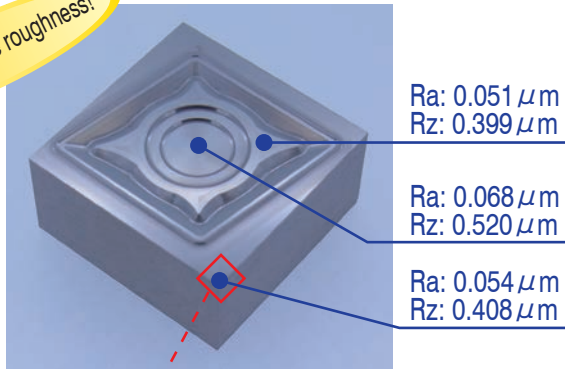
Tool after roughing



Tool after finishing

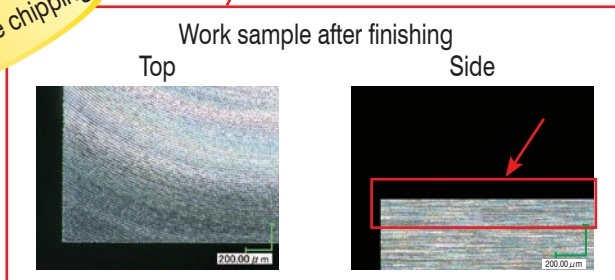
## Surface Roughness

Excellent surface roughness!



Size : 20 × 20 × 10 mm

Minimized edge chipping



UDCBF Series  
Indexable Insert Mold  
Milling Video



- ∅3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Size R0.3~R1



# UDCBH



Patent pending

Additional 2 models

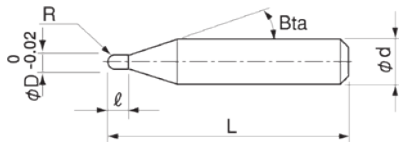
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |   |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|---|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |   |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |   |
|                               |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       | ○                | ★                                     | ● |

\* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

## Features

High efficiency and long life Ball End Mills for milling cemented carbide.  
 High-level treatment to reduce cutting resistance and mill at a high feed rate.  
 Wear resistance improved drastically with optimized Diamond coating.  
 Best for roughing and semi-finishing.



Label Sample



#001  $\phi D1.997 R+0.001/-0.001$

Diameter and Ball R accuracy measurements are printed on the label to support High Precision milling.

The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 6 models

Unit (mm)

| Model Number      | Radius of Ball Nose R | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-------------------|-----------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| ※ UDCBH 2006-0042 | R0.3                  | 0.42                 | 16°                   | 50               | 4                       | 44,160                   |
| ※ UDCBH 2007-0049 | R0.35                 | 0.49                 | 16°                   | 50               | 4                       | 44,160                   |
| UDCBH 2008-0056   | R0.4                  | 0.56                 | 16°                   | 50               | 4                       | 44,160                   |
| UDCBH 2010-0070   | R0.5                  | 0.7                  | 16°                   | 50               | 4                       | 44,160                   |
| UDCBH 2015-0105   | R0.75                 | 1.05                 | 16°                   | 50               | 4                       | 44,160                   |
| UDCBH 2020-0140   | R1                    | 1.4                  | 16°                   | 50               | 4                       | 44,160                   |

※Additional model



## Milling Conditions for UDCBH

| WORK MATERIAL |                          |                    | CEMENTED CARBIDE ( $\geq 87\text{HRA}$ ) |                    |                        |            |            | CEMENTED CARBIDE ( $< 87\text{HRA}$ ) |                    |                        |            |            | HARD BRITTLE MATERIALS              |                    |                        |            |            |
|---------------|--------------------------|--------------------|--|--------------------|------------------------|------------|------------|---------------------------------------|--------------------|------------------------|------------|------------|-------------------------------------|--------------------|------------------------|------------|------------|
| Model Number  | Radius of Ball Nose (mm) | Length of Cut (mm) | Spindle Speed ( $\text{min}^{-1}$ )      | Feed Rate (mm/min) | ※ Feed Rate 2 (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Spindle Speed ( $\text{min}^{-1}$ )   | Feed Rate (mm/min) | ※ Feed Rate 2 (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Spindle Speed ( $\text{min}^{-1}$ ) | Feed Rate (mm/min) | ※ Feed Rate 2 (mm/min) | $a_p$ (mm) | $a_e$ (mm) |
| 2006-0042     | R0.3                     | 0.42               | 30,000                                   | 600                | 200                    | 0.03       | 0.14       | 30,000                                | 900                | 300                    | 0.17       | 0.03       | 30,000                              | 200                | 20                     | 0.03       | 0.14       |
| 2007-0049     | R0.35                    | 0.49               | 30,000                                   | 690                | 230                    | 0.035      | 0.17       | 30,000                                | 1,050              | 350                    | 0.18       | 0.035      | 30,000                              | 225                | 23                     | 0.035      | 0.17       |
| 2008-0056     | R0.4                     | 0.56               | 30,000                                   | 750                | 250                    | 0.04       | 0.19       | 30,000                                | 1,250              | 420                    | 0.19       | 0.04       | 30,000                              | 250                | 25                     | 0.04       | 0.19       |
| 2010-0070     | R0.5                     | 0.7                | 30,000                                   | 900                | 300                    | 0.05       | 0.22       | 25,000                                | 1,300              | 430                    | 0.2        | 0.05       | 30,000                              | 300                | 30                     | 0.05       | 0.25       |
| 2015-0105     | R0.75                    | 1.05               | 30,000                                   | 1,200              | 400                    | 0.075      | 0.27       | 19,000                                | 1,450              | 480                    | 0.23       | 0.07       | 24,000                              | 400                | 45                     | 0.075      | 0.27       |
| 2020-0140     | R1                       | 1.4                | 30,000                                   | 1,500              | 500                    | 0.1        | 0.3        | 16,500                                | 1,600              | 530                    | 0.25       | 0.1        | 18,000                              | 600                | 200                    | 0.1        | 0.3        |

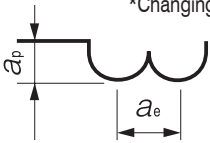
These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (TAS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only.

Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials.

For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

※ Feed Rate2: Feed rate of approach and \*connection moves.

\*Changing from one engagement point to the next.



- Note:
- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
  - Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
  - Tool setting length should achieve the least possible overhang.
  - Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
  - Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
  - Use an inclined or helical approach (Recommended inclination angle:  $< 5$  degree).
  - Decrease both spindle speed and feed rate proportionally.
  - Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
  - Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
  - When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
  - Remove chips to prevent heat generation and ignition during milling process.
  - Protective gear, such as safety glasses and face guards are required when milling.
  - Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.
  - The tool life may shorten due to a large difference between the commanded feed speed and the actual machining speed caused by factors as machining model and machining machine.
  - Decrease both feed rate and feed rate 2 proportionally.
  - Tool damage may progress rapidly near the end of the tool life.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.1~R3



**UDCBF**



Patented in Japan, US, China, Korea, Germany, Switzerland, and Liechtenstein

Additional 1 model

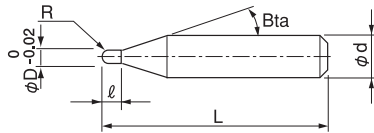
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material |                 |                    |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |   |
|---------------|-----------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|---|
| Carbon Steels | Alloy Steels    | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |   |
|               |                 |                    | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |   |
| S45C<br>S55C  | SK / SCM<br>SUS | NAK<br>HPM         |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       | ○                | ★                                     | ● |

\* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

**Features**

Ball type End Mills for milling Cemented Carbide and Hard Brittle (Non-Metallic) Materials. Upgraded version of UDCB. New Diamond coating and flute design increase material removal amount. Chip pocket designed on tool tip improves the surface finishing quality. Special cutting edge treatment helps to avoid the edge chipping & level gap. Recommended to use on semi-roughing & finishing process.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Label Sample



#001 φD0.797 R+0.003/0.000

Diameter and Ball R accuracy measurements are printed on the label to support High Precision milling.

Total 17 models

Unit (mm)

| Model Number      | Radius of Ball Nose R | Length of Cut ℓ | Shank Taper Angle Bta | Overall Length L | Shank Diameter φd | Suggested Retail Price ¥ |
|-------------------|-----------------------|-----------------|-----------------------|------------------|-------------------|--------------------------|
| UDCBF 2002-0014   | R0.1                  | 0.14            | 16°                   | 50               | 4                 | 47,000                   |
| UDCBF 2003-0021   | R0.15                 | 0.21            | 16°                   | 50               | 4                 | 47,000                   |
| UDCBF 2004-0028   | R0.2                  | 0.28            | 16°                   | 50               | 4                 | 42,800                   |
| UDCBF 2005-0035   | R0.25                 | 0.35            | 16°                   | 50               | 4                 | 42,800                   |
| UDCBF 2006-0042   | R0.3                  | 0.42            | 16°                   | 50               | 4                 | 38,400                   |
| UDCBF 2007-0049   | R0.35                 | 0.49            | 16°                   | 50               | 4                 | 38,400                   |
| UDCBF 2008-0056   | R0.4                  | 0.56            | 16°                   | 50               | 4                 | 38,400                   |
| UDCBF 2009-0063   | R0.45                 | 0.63            | 16°                   | 50               | 4                 | 38,400                   |
| UDCBF 2010-0070   | R0.5                  | 0.7             | 16°                   | 50               | 4                 | 38,400                   |
| UDCBF 2012-0084   | R0.6                  | 0.84            | 16°                   | 50               | 4                 | 38,400                   |
| UDCBF 2015-0105   | R0.75                 | 1.05            | 16°                   | 50               | 4                 | 38,400                   |
| UDCBF 2020-0140   | R1                    | 1.4             | 16°                   | 50               | 4                 | 38,400                   |
| ※ UDCBF 2025-0175 | R1.25                 | 1.75            | 16°                   | 50               | 4                 | 42,300                   |
| UDCBF 2030-0210   | R1.5                  | 2.1             | 16°                   | 60               | 6                 | 42,300                   |
| UDCBF 2040-0280   | R2                    | 2.8             | 16°                   | 60               | 6                 | 42,300                   |
| UDCBF 2050-0350   | R2.5                  | 3.5             | 16°                   | 60               | 6                 | 42,300                   |
| UDCBF 2060-0420   | R3                    | 4.2             | —                     | 60               | 6                 | 42,300                   |

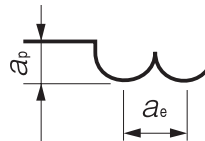
※Additional model

## Milling Conditions for UDCBF

| WORK MATERIAL |                          |                    | CEMENTED CARBIDE (≥87HRA)<br>HARD BRITTLE MATERIALS |                    |                       |            |            | CEMENTED CARBIDE (<87HRA)          |                    |                       |            |            |
|---------------|--------------------------|--------------------|---|--------------------|-----------------------|------------|------------|------------------------------------|--------------------|-----------------------|------------|------------|
| Model Number  | Radius of Ball Nose (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | *Feed Rate 2 (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | *Feed Rate 2 (mm/min) | $a_p$ (mm) | $a_e$ (mm) |
| 2002-0014     | R0.1                     | 0.14               | 30,000  | 100                | 10                    | 0.01       | 0.01       | 30,000                             | 100                | 10                    | 0.01       | 0.01       |
| 2003-0021     | R0.15                    | 0.21               | 30,000  | 125                | 13                    | 0.015      | 0.03       | 30,000                             | 125                | 13                    | 0.015      | 0.03       |
| 2004-0028     | R0.2                     | 0.28               | 30,000  | 150                | 15                    | 0.02       | 0.08       | 30,000                             | 150                | 15                    | 0.02       | 0.08       |
| 2005-0035     | R0.25                    | 0.35               | 30,000  | 175                | 18                    | 0.025      | 0.11       | 30,000                             | 175                | 18                    | 0.025      | 0.11       |
| 2006-0042     | R0.3                     | 0.42               | 30,000  | 200                | 20                    | 0.03       | 0.14       | 30,000                             | 200                | 20                    | 0.03       | 0.14       |
| 2007-0049     | R0.35                    | 0.49               | 30,000  | 225                | 23                    | 0.035      | 0.17       | 30,000                             | 225                | 23                    | 0.035      | 0.17       |
| 2008-0056     | R0.4                     | 0.56               | 30,000  | 250                | 25                    | 0.04       | 0.19       | 30,000                             | 250                | 25                    | 0.04       | 0.19       |
| 2009-0063     | R0.45                    | 0.63               | 30,000  | 275                | 28                    | 0.045      | 0.22       | 30,000                             | 275                | 28                    | 0.045      | 0.22       |
| 2010-0070     | R0.5                     | 0.7                | 30,000  | 300                | 30                    | 0.05       | 0.25       | 30,000                             | 300                | 150                   | 0.35       | 0.075      |
| 2012-0084     | R0.6                     | 0.84               | 27,500  | 275                | 36                    | 0.06       | 0.26       | 25,000                             | 250                | 125                   | 0.42       | 0.09       |
| 2015-0105     | R0.75                    | 1.05               | 25,000  | 250                | 45                    | 0.075      | 0.27       | 19,000                             | 190                | 95                    | 0.525      | 0.12       |
| 2020-0140     | R1                       | 1.4                | 20,000  | 200                | 60                    | 0.1        | 0.3        | 12,500                             | 125                | 60                    | 0.7        | 0.15       |
| 2025-0175     | R1.25                    | 1.75               | 20,000  | 200                | 60                    | 0.12       | 0.3        | 10,000                             | 100                | 50                    | 0.8        | 0.18       |
| 2030-0210     | R1.5                     | 2.1                | 20,000  | 200                | 100                   | 0.15       | 0.3        | 9,000                              | 280                | 140                   | 0.38       | 0.15       |
| 2040-0280     | R2                       | 2.8                | 18,000  | 180                | 90                    | 0.175      | 0.32       | 7,200                              | 280                | 140                   | 0.5        | 0.2        |
| 2050-0350     | R2.5                     | 3.5                | 16,000  | 160                | 80                    | 0.225      | 0.31       | 6,000                              | 330                | 170                   | 0.6        | 0.25       |
| 2060-0420     | R3                       | 4.2                | 15,000  | 150                | 75                    | 0.3        | 0.3        | 5,500                              | 280                | 140                   | 0.65       | 0.28       |

These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (TAS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only. Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials. For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

※ Feed Rate2: Feed rate of approach and \*connection moves.  
\*Changing from one engagement point to the next.



- Note:
- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
  - Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
  - Tool setting length should achieve the least possible overhang.
  - Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
  - Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
  - Use an inclined or helical approach (Recommended inclination angle: <5 degree).
  - Decrease both spindle speed and feed rate proportionally.
  - Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
  - Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
  - When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
  - Remove chips to prevent heat generation and ignition during milling process.
  - Protective gear, such as safety glasses and face guards are required when milling.
  - Chips / dust generated while milling can have adverse effects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.1~R3



**UDCB**



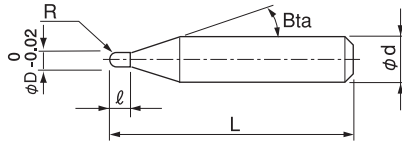
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material |                 |                    |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |         |
|---------------|-----------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|---------|
| Carbon Steels | Alloy Steels    | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |         |
|               |                 |                    | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |         |
| S45C<br>S55C  | SK / SCM<br>SUS | NAK<br>HPM         |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       | ○<br>*1          | ★                                     | ●<br>*2 |

\*1 DCB/DCLB series are highly recommended for Glass Filled Plastic milling.  
 \*2 Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

**Features**

Ball type End Mills for milling Cemented Carbide and Hard Brittle (Non-Metallic) Materials. Developed to give improved hardness and durability, new Diamond coating also has outstanding adhesion to the cutting tool. By combining the new coating with optimum cutting geometries, the tool “deep cuts” the work piece. Leaves a burr and pit free surface finish on semi-roughing & finishing process.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Label Sample



#001 φD1.983 R0.000/-0.005

Diameter and Ball R accuracy measurements are printed on the label to support High Precision milling.

Total 14 models

Unit (mm)

| Model Number   | Radius of Ball Nose R | Length of Cut ℓ | Shank Taper Angle Bta | Overall Length L | Shank Diameter φd | Suggested Retail Price ¥ |
|----------------|-----------------------|-----------------|-----------------------|------------------|-------------------|--------------------------|
| UDCB 2002-0014 | R0.1                  | 0.14            | 16°                   | 50               | 4                 | 39,160                   |
| UDCB 2003-0021 | R0.15                 | 0.21            | 16°                   | 50               | 4                 | 39,160                   |
| UDCB 2004-0028 | R0.2                  | 0.28            | 16°                   | 50               | 4                 | 35,660                   |
| UDCB 2005-0035 | R0.25                 | 0.35            | 16°                   | 50               | 4                 | 35,660                   |
| UDCB 2006-0042 | R0.3                  | 0.42            | 16°                   | 50               | 4                 | 32,000                   |
| UDCB 2007-0049 | R0.35                 | 0.49            | 16°                   | 50               | 4                 | 32,000                   |
| UDCB 2008-0056 | R0.4                  | 0.56            | 16°                   | 50               | 4                 | 32,000                   |
| UDCB 2009-0063 | R0.45                 | 0.63            | 16°                   | 50               | 4                 | 32,000                   |
| UDCB 2010-0070 | R0.5                  | 0.7             | 16°                   | 50               | 4                 | 32,000                   |
| UDCB 2020-0140 | R1                    | 1.4             | 16°                   | 50               | 4                 | 32,000                   |
| UDCB 2030-0210 | R1.5                  | 2.1             | 16°                   | 60               | 6                 | 35,160                   |
| UDCB 2040-0280 | R2                    | 2.8             | 16°                   | 60               | 6                 | 35,160                   |
| UDCB 2050-0350 | R2.5                  | 3.5             | 16°                   | 60               | 6                 | 35,160                   |
| UDCB 2060-0420 | R3                    | 4.2             | —                     | 60               | 6                 | 35,160                   |

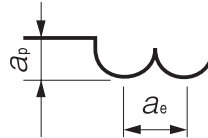
## Milling Conditions for UDCB

| WORK MATERIAL |                          |                    | CEMENTED CARBIDE (≥87HRA)          |                    |                        |            |            | CEMENTED CARBIDE (<87HRA)          |                    |                        |            |            | HARD BRITTLE MATERIALS             |                    |                        |            |            |
|---------------|--------------------------|--------------------|------------------------------------|--------------------|------------------------|------------|------------|------------------------------------|--------------------|------------------------|------------|------------|------------------------------------|--------------------|------------------------|------------|------------|
| Model Number  | Radius of Ball Nose (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | ※ Feed Rate 2 (mm/min) | $a_p$ (mm) | $a_p$ (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | ※ Feed Rate 2 (mm/min) | $a_p$ (mm) | $a_p$ (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | ※ Feed Rate 2 (mm/min) | $a_p$ (mm) | $a_e$ (mm) |
| 2002-0014     | R0.1                     | 0.14               | 30,000                             | 100                | 10                     | 0.01       | 0.01       | 30,000                             | 100                | 10                     | 0.01       | 0.01       | 30,000                             | 100                | 10                     | 0.01       | 0.01       |
| 2003-0021     | R0.15                    | 0.21               | 30,000                             | 125                | 13                     | 0.015      | 0.03       | 30,000                             | 125                | 13                     | 0.015      | 0.03       | 30,000                             | 125                | 13                     | 0.015      | 0.03       |
| 2004-0028     | R0.2                     | 0.28               | 30,000                             | 150                | 15                     | 0.02       | 0.08       | 30,000                             | 150                | 15                     | 0.02       | 0.08       | 30,000                             | 150                | 15                     | 0.02       | 0.08       |
| 2005-0035     | R0.25                    | 0.35               | 30,000                             | 175                | 18                     | 0.025      | 0.11       | 30,000                             | 175                | 18                     | 0.025      | 0.11       | 30,000                             | 175                | 18                     | 0.025      | 0.11       |
| 2006-0042     | R0.3                     | 0.42               | 30,000                             | 200                | 20                     | 0.03       | 0.14       | 30,000                             | 200                | 20                     | 0.03       | 0.14       | 30,000                             | 200                | 20                     | 0.03       | 0.14       |
| 2007-0049     | R0.35                    | 0.49               | 30,000                             | 225                | 23                     | 0.035      | 0.17       | 30,000                             | 225                | 23                     | 0.035      | 0.17       | 30,000                             | 225                | 23                     | 0.035      | 0.17       |
| 2008-0056     | R0.4                     | 0.56               | 30,000                             | 250                | 25                     | 0.04       | 0.19       | 30,000                             | 250                | 25                     | 0.04       | 0.19       | 30,000                             | 250                | 25                     | 0.04       | 0.19       |
| 2009-0063     | R0.45                    | 0.63               | 30,000                             | 275                | 28                     | 0.045      | 0.22       | 30,000                             | 275                | 28                     | 0.045      | 0.22       | 30,000                             | 275                | 28                     | 0.045      | 0.22       |
| 2010-0070     | R0.5                     | 0.7                | 30,000                             | 300                | 30                     | 0.05       | 0.25       | 20,000                             | 400                | 200                    | 0.35       | 0.075      | 30,000                             | 300                | 30                     | 0.05       | 0.25       |
| 2020-0140     | R1                       | 1.4                | 30,000                             | 300                | 100                    | 0.1        | 0.3        | 16,500                             | 420                | 210                    | 0.25       | 0.1        | 24,000                             | 240                | 100                    | 0.1        | 0.3        |
| 2030-0210     | R1.5                     | 2.1                | 27,500                             | 275                | 140                    | 0.125      | 0.33       | 11,000                             | 280                | 140                    | 0.38       | 0.15       | 24,000                             | 240                | 120                    | 0.125      | 0.33       |
| 2040-0280     | R2                       | 2.8                | 24,000                             | 240                | 120                    | 0.15       | 0.35       | 8,250                              | 300                | 150                    | 0.5        | 0.2        | 24,000                             | 240                | 120                    | 0.15       | 0.35       |
| 2050-0350     | R2.5                     | 3.5                | 22,000                             | 220                | 110                    | 0.175      | 0.37       | 6,600                              | 330                | 160                    | 0.6        | 0.25       | 22,000                             | 220                | 110                    | 0.175      | 0.37       |
| 2060-0420     | R3                       | 4.2                | 20,000                             | 200                | 100                    | 0.2        | 0.4        | 5,500                              | 280                | 140                    | 0.65       | 0.28       | 20,000                             | 200                | 100                    | 0.2        | 0.4        |

These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (TAS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only.

Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials. For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

- ※ Feed Rate2: Feed rate of approach and \*connection moves.  
\*Changing from one engagement point to the next.



- Note:
- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
  - Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
  - Tool setting length should achieve the least possible overhang.
  - Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
  - Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
  - Use an inclined or helical approach (Recommended inclination angle: <5 degree).
  - Decrease both spindle speed and feed rate proportionally.
  - Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
  - Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
  - When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
  - Remove chips to prevent heat generation and ignition during milling process.
  - Protective gear, such as safety glasses and face guards are required when milling.
  - Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

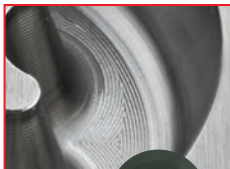
Drill

Technical Data

Cemented Carbide Hexalobular milled with UDCB R0.5 x L0.7

VF-20 (92.5HRA)

One R0.5 ball end mill removed 91 mm<sup>3</sup> of material



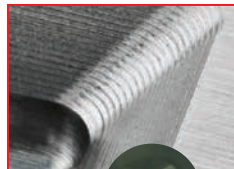
Work size:  $\phi 9$  x Depth 2.2 mm

|                         |  |
|-------------------------|--|
| Spindle Speed           | 30,000 min <sup>-1</sup>                       |
| Feed Rate               | 300 mm/min                                     |
| $a_p$                   | 0.05 mm  |
| $a_e$                   | 0.3 mm (Bottom Surface $a_e=0.05$ mm)          |
| Coolant                 | Oil Mist                                       |
| Cycle Time              | 39 min   |
| Material Removal Amount | 91.7 mm <sup>3</sup> 2.35 mm <sup>3</sup> /min |

Cemented Carbide Pyramid milled with UDCB R0.5 x L0.7

VM-40 (90HRA)

Clean cutter traces! Equal surface condition!



Work size: 6.6 mm x Depth 1.85 mm

|                         |  |
|-------------------------|--|
| Spindle Speed           | 30,000 min <sup>-1</sup>                       |
| Feed Rate               | 300 mm/min                                     |
| $a_p$                   | 0.05 mm  |
| $a_e$                   | 0.25 mm (Bottom Surface $a_e=0.05$ mm)         |
| Coolant                 | Oil Mist                                       |
| Cycle Time              | 24 min   |
| Material Removal Amount | 41.3 mm <sup>3</sup> 1.72 mm <sup>3</sup> /min |

UDCB Series  
VM-40(90HRA)  
Pyramid Milling Video



UDCB Series  
VF-20(92.5HRA)  
Hexalobular Milling Video



Versatile coating!

## Alumina / Zirconia Hexalobular milled with UDCB R0.5 x L0.7

Alumina  $Al_2O_3$ Zirconia  $ZrO_2$ Size :  $\phi 9 \times$  Depth 2.2 mm

|                         |                                      |
|-------------------------|--------------------------------------|
| Tool                    | UDCB 2010-0070 (R0.5 x 0.7)          |
| Work Material           | Alumina $Al_2O_3$ / Zirconia $ZrO_2$ |
| Spindle Speed           | 30,000 $min^{-1}$                    |
| Feed Rate               | 300 mm/min                           |
| $a_p$                   | 0.05 mm                              |
| $a_e$                   | 0.05 mm                              |
| Coolant                 | Air Blow (Nozzle)                    |
| Cycle Time              | 98 min                               |
| Material Removal Amount | 88.4 $mm^3$ 0.9 $mm^3/min$           |

$\phi 3mm$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral

V Cutter

Drill

Technical Data



Size R0.3~R1



# UDCLBH



Patent pending **NEW**

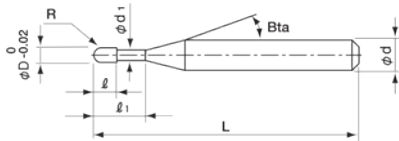
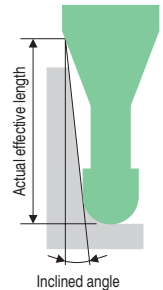
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material |                 |                    |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|---------------|-----------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels | Alloy Steels    | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|               |                 |                    | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| S45C<br>S55C  | SK / SCM<br>SUS | NAK<br>HPM         |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       | ★                | ●<br>*                                |

\* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

## Features

**Long life Long Neck Ball End Mills for milling Cemented Carbide.**  
**High-level treatment to reduce cutting resistance and minimize damage on cutting edge.**  
**Wear resistance improved drastically with optimized diamond coating.**  
**Best for roughing and semi-finishing.**



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Label Sample



#001 φD1.989 R0.000/-0.002

Diameter and Ball R accuracy measurements are printed on the label to support High Precision milling.

Total 22 models

Unit (mm)

| Model Number     | Radius of Ball Nose R | Effective Length ℓ <sub>1</sub> | Length of Cut ℓ | Neck Diameter φ <sub>d1</sub> | Shank Taper Angle Bta | Overall Length L | Shank Diameter φ <sub>d</sub> | Suggested Retail Price ¥ | Effective Length by Inclined Angles |      |       |      |      |
|------------------|-----------------------|---------------------------------|-----------------|-------------------------------|-----------------------|------------------|-------------------------------|--------------------------|-------------------------------------|------|-------|------|------|
|                  |                       |                                 |                 |                               |                       |                  |                               |                          | 30°                                 | 1°   | 1°30' | 2°   | 3°   |
| UDCLBH 2006-0100 | R0.3                  | 1                               | 0.42            | 0.575                         | 16°                   | 50               | 4                             | 44,740                   | 1.03                                | 1.05 | 1.08  | 1.10 | 1.17 |
| UDCLBH 2006-0150 |                       | 1.5                             |                 |                               |                       |                  |                               |                          | 1.54                                | 1.58 | 1.63  | 1.67 | 1.78 |
| UDCLBH 2006-0200 |                       | 2                               |                 |                               |                       |                  |                               |                          | 2.06                                | 2.12 | 2.18  | 2.24 | 2.39 |
| UDCLBH 2006-0300 |                       | 3                               |                 |                               |                       |                  |                               |                          | 3.09                                | 3.18 | 3.28  | 3.38 | 3.61 |
| UDCLBH 2007-0100 | R0.35                 | 1                               | 0.49            | 0.675                         | 16°                   | 50               | 4                             | 44,740                   | 1.02                                | 1.05 | 1.07  | 1.10 | 1.16 |
| UDCLBH 2008-0200 | R0.4                  | 2                               | 0.56            | 0.775                         | 16°                   | 50               | 4                             | 44,740                   | 2.05                                | 2.11 | 2.17  | 2.23 | 2.37 |
| UDCLBH 2008-0300 |                       | 3                               |                 |                               |                       |                  |                               |                          | 3.09                                | 3.17 | 3.27  | 3.37 | 3.59 |
| UDCLBH 2008-0400 |                       | 4                               |                 |                               |                       |                  |                               |                          | 4.12                                | 4.24 | 4.37  | 4.51 | 4.82 |



Unit (mm)

| Model Number     | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi_{d_1}$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi_d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |       |       |
|------------------|-----------------------|---------------------------|----------------------|----------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|-------|-------|
|                  |                       |                           |                      |                            |                       |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°    | 3°    |
| UDCLBH 2010-0150 | R0.5                  | 1.5                       | 0.7                  | 0.975                      | 16°                   | 50               | 4                       | 44,740                   | 1.54                                | 1.57  | 1.61  | 1.65  | 1.73  |
| UDCLBH 2010-0200 |                       | 2                         |                      |                            |                       |                  |                         |                          | 2.05                                | 2.10  | 2.16  | 2.22  | 2.35  |
| UDCLBH 2010-0250 |                       | 2.5                       |                      |                            |                       |                  |                         |                          | 2.57                                | 2.63  | 2.71  | 2.78  | 2.96  |
| UDCLBH 2010-0300 |                       | 3                         |                      |                            |                       |                  |                         |                          | 3.08                                | 3.17  | 3.26  | 3.35  | 3.57  |
| UDCLBH 2010-0400 |                       | 4                         |                      |                            |                       |                  |                         |                          | 4.11                                | 4.23  | 4.36  | 4.49  | 4.79  |
| UDCLBH 2010-0500 |                       | 5                         |                      |                            |                       |                  |                         |                          | 5.15                                | 5.30  | 5.46  | 5.63  | 6.02  |
| UDCLBH 2015-0200 | R0.75                 | 2                         | 1.05                 | 1.455                      | 16°                   | 50               | 4                       | 44,740                   | 2.08                                | 2.12  | 2.17  | 2.22  | 2.33  |
| UDCLBH 2015-0400 |                       | 4                         |                      |                            |                       |                  |                         |                          | 4.14                                | 4.25  | 4.37  | 4.50  | 4.78  |
| UDCLBH 2015-0600 |                       | 6                         |                      |                            |                       |                  |                         |                          | 6.21                                | 6.38  | 6.57  | 6.78  | 7.23  |
| UDCLBH 2020-0300 | R1                    | 3                         | 1.4                  | 1.915                      | 16°                   | 50               | 4                       | 44,740                   | 3.18                                | 3.25  | 3.32  | 3.41  | 3.59  |
| UDCLBH 2020-0400 |                       | 4                         |                      |                            |                       |                  |                         |                          | 4.21                                | 4.31  | 4.42  | 4.54  | 4.81  |
| UDCLBH 2020-0600 |                       | 6                         |                      |                            |                       |                  |                         |                          | 6.27                                | 6.44  | 6.62  | 6.82  | 7.26  |
| UDCLBH 2020-0800 |                       | 8                         |                      |                            |                       |                  |                         |                          | 8.33                                | 8.57  | 8.83  | 9.10  | 9.71  |
| UDCLBH 2020-1000 |                       | 10                        |                      |                            |                       |                  |                         |                          | 10.39                               | 10.70 | 11.03 | 11.38 | 12.15 |

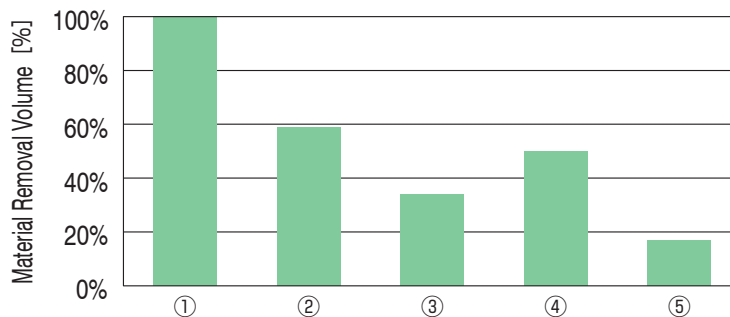
### [UDC Milling Tips]

Tool life (= material removal volume) changes depending on the difference in Cemented Carbide material. Recommend to select a material with good workability while considering the required performance (mold life).

| Cemented Carbide | TAS Standard | Density g/cm <sup>3</sup> | Hardness HRA | Flexural Strength MPa | Compressive Strength MPa | Co Amount* % | Grain Size $\mu\text{m}$ |
|------------------|--------------|---------------------------|--------------|-----------------------|--------------------------|--------------|--------------------------|
| ①                | VF-20        | 14.1                      | 92.5~93      | 4,500~5,000           | —                        | 12           | 0.5                      |
| ②                | VM-40        | 14.7                      | 90           | 3,240                 | 4,700                    | 8.8          | 2~3                      |
| ③                | VM-40        | 14.3                      | 89           | 3,400                 | —                        | 13.6         | —                        |
| ④                | VM-50        | 14.2                      | 87.5         | 3,160                 | 4,070                    | 15.1         | —                        |
| ⑤                | —            | 13.1                      | 83           | 2,660                 | 2,800                    | 28.9         | —                        |

\*In-house measurement

UDCB R0.5 Comparison of material removal volume (① equals 100%)



※ The ratio varies depending on the series, tool design, and sizes.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

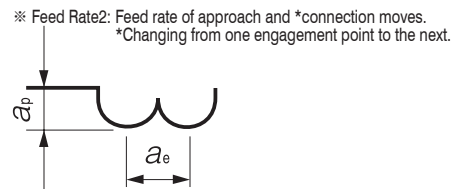
Drill

Technical Data

## Milling Conditions for UDCLBH

| WORK MATERIAL |                          |                       | CEMENTED CARBIDE (≥87HRA) / HARD BRITTLE MATERIALS |                    |                       |                     |                     | CEMENTED CARBIDE (<87HRA)          |                    |                       |                     |                     | HARD BRITTLE MATERIALS             |                    |                       |                     |                     |
|---------------|--------------------------|-----------------------|--|--------------------|-----------------------|---------------------|---------------------|------------------------------------|--------------------|-----------------------|---------------------|---------------------|------------------------------------|--------------------|-----------------------|---------------------|---------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                 | Feed Rate (mm/min) | ※Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | ※Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | ※Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |
| 2006-0100     | R0.3                     | 1                     | 30,000   | 600                | 200                   | 0.03                | 0.14                | 30,000                             | 450                | 150                   | 0.17                | 0.03                | 30,000                             | 200                | 20                    | 0.03                | 0.14                |
| 2006-0150     |                          | 1.5                   | 30,000   | 600                | 200                   | 0.03                | 0.14                | 30,000                             | 300                | 100                   | 0.14                | 0.025               | 30,000                             | 200                | 20                    | 0.03                | 0.14                |
| 2006-0200     |                          | 2                     | 30,000   | 300                | 100                   | 0.022               | 0.11                | 30,000                             | 220                | 70                    | 0.11                | 0.02                | 30,000                             | 150                | 15                    | 0.02                | 0.11                |
| 2006-0300     |                          | 3                     | 30,000   | 75                 | 10                    | 0.01                | 0.08                | 30,000                             | 75                 | 10                    | 0.08                | 0.01                | 30,000                             | 75                 | 10                    | 0.01                | 0.08                |
| 2007-0100     | R0.35                    | 1                     | 30,000   | 690                | 230                   | 0.035               | 0.17                | 30,000                             | 525                | 260                   | 0.18                | 0.035               | 30,000                             | 225                | 23                    | 0.035               | 0.17                |
| 2008-0200     | R0.4                     | 2                     | 30,000   | 750                | 250                   | 0.04                | 0.19                | 27,000                             | 480                | 240                   | 0.19                | 0.04                | 30,000                             | 250                | 25                    | 0.04                | 0.19                |
| 2008-0300     |                          | 3                     | 30,000   | 350                | 100                   | 0.037               | 0.17                | 25,500                             | 300                | 100                   | 0.17                | 0.035               | 30,000                             | 230                | 23                    | 0.037               | 0.17                |
| 2008-0400     |                          | 4                     | 26,000   | 210                | 70                    | 0.035               | 0.16                | 24,000                             | 210                | 21                    | 0.16                | 0.035               | 30,000                             | 210                | 21                    | 0.035               | 0.16                |
| 2010-0150     | R0.5                     | 1.5                   | 30,000   | 900                | 300                   | 0.05                | 0.22                | 25,000                             | 650                | 325                   | 0.2                 | 0.05                | 30,000                             | 300                | 30                    | 0.05                | 0.25                |
| 2010-0200     |                          | 2                     | 30,000   | 900                | 300                   | 0.05                | 0.22                | 24,000                             | 580                | 290                   | 0.2                 | 0.05                | 30,000                             | 300                | 30                    | 0.05                | 0.25                |
| 2010-0250     |                          | 2.5                   | 30,000   | 800                | 300                   | 0.05                | 0.22                | 23,500                             | 520                | 260                   | 0.2                 | 0.05                | 30,000                             | 300                | 30                    | 0.05                | 0.25                |
| 2010-0300     |                          | 3                     | 30,000   | 600                | 200                   | 0.05                | 0.22                | 23,000                             | 450                | 220                   | 0.2                 | 0.05                | 30,000                             | 300                | 30                    | 0.05                | 0.25                |
| 2010-0400     |                          | 4                     | 30,000   | 400                | 100                   | 0.05                | 0.22                | 21,000                             | 320                | 160                   | 0.2                 | 0.05                | 30,000                             | 300                | 30                    | 0.05                | 0.25                |
| 2010-0500     |                          | 5                     | 27,000   | 270                | 100                   | 0.045               | 0.2                 | 20,000                             | 250                | 125                   | 0.2                 | 0.05                | 27,000                             | 270                | 30                    | 0.045               | 0.2                 |
| 2015-0200     |                          | R0.75                 | 2  | 30,000             | 1,200                 | 400                 | 0.075               | 0.27                               | 19,000             | 750                   | 375                 | 0.23                | 0.07                               | 24,000             | 400                   | 45                  | 0.075               |
| 2015-0400     | 4                        |                       | 30,000   | 900                | 250                   | 0.075               | 0.27                | 18,000                             | 580                | 290                   | 0.23                | 0.07                | 24,000                             | 350                | 40                    | 0.075               | 0.27                |
| 2015-0600     | 6                        |                       | 25,000   | 500                | 100                   | 0.075               | 0.27                | 17,000                             | 400                | 200                   | 0.23                | 0.07                | 24,000                             | 320                | 36                    | 0.075               | 0.27                |
| 2020-0300     | R1                       | 3                     | 30,000   | 1,500              | 500                   | 0.1                 | 0.3                 | 16,500                             | 800                | 400                   | 0.25                | 0.1                 | 18,000                             | 600                | 200                   | 0.1                 | 0.3                 |
| 2020-0400     |                          | 4                     | 30,000   | 1,500              | 500                   | 0.1                 | 0.3                 | 15,750                             | 750                | 375                   | 0.25                | 0.1                 | 18,000                             | 500                | 160                   | 0.1                 | 0.3                 |
| 2020-0600     |                          | 6                     | 20,000   | 850                | 280                   | 0.1                 | 0.3                 | 15,000                             | 620                | 310                   | 0.25                | 0.1                 | 18,000                             | 400                | 130                   | 0.1                 | 0.3                 |
| 2020-0800     |                          | 8                     | 13,000   | 400                | 130                   | 0.1                 | 0.3                 | 14,000                             | 520                | 260                   | 0.25                | 0.1                 | 18,000                             | 350                | 120                   | 0.1                 | 0.3                 |
| 2020-1000     |                          | 10                    | 10,000   | 200                | 60                    | 0.1                 | 0.3                 | 13,000                             | 420                | 210                   | 0.25                | 0.1                 | 18,000                             | 300                | 100                   | 0.1                 | 0.3                 |

These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (TAS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only. Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials. For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.



**Note:**

- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank.  
This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Use an inclined or helical approach (Recommended inclination angle: <5 degree).
- Decrease both spindle speed and feed rate proportionally.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.
- The tool life may shorten due to a large difference between the commanded feed speed and the actual machining speed caused by factors as machining model and machining machine.
- Decrease both feed rate and feed rate 2 proportionally.
- Tool damage may progress rapidly near the end of the tool life.

∅3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.1~R3



# UDCLBF



Patented in Japan, US, China, Korea, Germany, Switzerland, and Liechtenstein

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material |                 |                    |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|---------------|-----------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels | Alloy Steels    | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|               |                 |                    | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| S45C<br>S55C  | SK / SCM<br>SUS | NAK<br>HPM         |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       | ★                | ●<br>*                                |

\* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

## Features

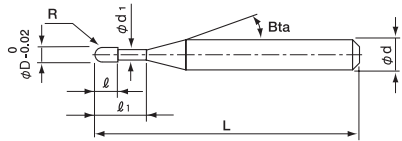
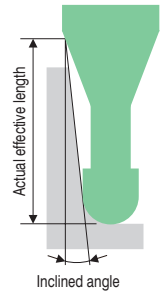
Long Neck Ball type End Mills for milling Cemented Carbide and Hard Brittle (Non-Metallic) Materials. Upgraded version of UDCLB.

New Diamond coating and flute design increase material removal amount.

Chip pocket designed on tool tip improves the surface finishing quality.

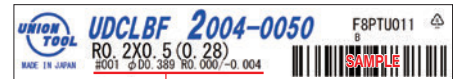
Special cutting edge treatment helps to avoid the edge chipping & level gap.

Recommended to use on semi-roughing & finishing process.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Label Sample



#001 φD0.389 R0.000/-0.004

Diameter and Ball R accuracy measurements are printed on the label to support High Precision milling.

Total 61 models

Unit (mm)

| Model Number     | Radius of Ball Nose R | Effective Length ℓ <sub>1</sub> | Length of Cut ℓ | Neck Diameter φ <sub>d1</sub> | Shank Taper Angle B <sub>ta</sub> | Overall Length L | Shank Diameter φ <sub>d</sub> | Suggested Retail Price ¥ | Effective Length by Inclined Angles |      |       |      |      |
|------------------|-----------------------|---------------------------------|-----------------|-------------------------------|-----------------------------------|------------------|-------------------------------|--------------------------|-------------------------------------|------|-------|------|------|
|                  |                       |                                 |                 |                               |                                   |                  |                               |                          | 30°                                 | 1°   | 1°30' | 2°   | 3°   |
| UDCLBF 2002-0030 | R0.1                  | 0.3                             | 0.14            | 0.18                          | 16°                               | 50               | 4                             | 47,500                   | 0.30                                | 0.31 | 0.32  | 0.32 | 0.34 |
| UDCLBF 2002-0050 |                       | 0.5                             |                 |                               |                                   |                  |                               |                          | 0.51                                | 0.52 | 0.54  | 0.55 | 0.59 |
| UDCLBF 2002-0075 |                       | 0.75                            |                 |                               |                                   |                  |                               |                          | 0.77                                | 0.79 | 0.81  | 0.84 | 0.89 |
| UDCLBF 2002-0100 |                       | 1                               |                 |                               |                                   |                  |                               |                          | 1.02                                | 1.05 | 1.09  | 1.12 | 1.20 |
| UDCLBF 2003-0050 | R0.15                 | 0.5                             | 0.21            | 0.28                          | 16°                               | 50               | 4                             | 47,500                   | 0.51                                | 0.52 | 0.53  | 0.55 | 0.58 |
| UDCLBF 2003-0075 |                       | 0.75                            |                 |                               |                                   |                  |                               |                          | 0.76                                | 0.78 | 0.81  | 0.83 | 0.88 |
| UDCLBF 2003-0100 |                       | 1                               |                 |                               |                                   |                  |                               |                          | 1.02                                | 1.05 | 1.08  | 1.11 | 1.19 |
| UDCLBF 2004-0050 | R0.2                  | 0.5                             | 0.28            | 0.36                          | 16°                               | 50               | 4                             | 43,300                   | 0.54                                | 0.55 | 0.56  | 0.58 | 0.61 |
| UDCLBF 2004-0100 |                       | 1                               |                 |                               |                                   |                  |                               |                          | 1.06                                | 1.08 | 1.12  | 1.15 | 1.22 |
| UDCLBF 2004-0150 |                       | 1.5                             |                 |                               |                                   |                  |                               |                          | 1.57                                | 1.62 | 1.67  | 1.72 | 1.83 |
| UDCLBF 2004-0200 |                       | 2                               |                 |                               |                                   |                  |                               |                          | 2.09                                | 2.15 | 2.22  | 2.29 | 2.44 |
| UDCLBF 2004-0250 |                       | 2.5                             |                 |                               |                                   |                  |                               |                          | 2.60                                | 2.68 | 2.77  | 2.86 | 3.06 |

Unit (mm)

| Model Number     | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bia | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|------------------|-----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|                  |                       |                           |                      |                          |                       |                  |                         |                          | 30°                                 | 1°              | 1°30'           | 2°              | 3°              |
| UDCLBF 2006-0100 | R0.3                  | 1                         | 0.42                 | 0.56                     | 16°                   | 50               | 4                       | 38,900                   | 1.05                                | 1.08            | 1.11            | 1.13            | 1.20            |
| UDCLBF 2006-0150 |                       | 1.5                       |                      |                          |                       |                  |                         |                          | 1.57                                | 1.61            | 1.66            | 1.70            | 1.81            |
| UDCLBF 2006-0200 |                       | 2                         |                      |                          |                       |                  |                         |                          | 2.08                                | 2.14            | 2.21            | 2.27            | 2.42            |
| UDCLBF 2006-0300 |                       | 3                         |                      |                          |                       |                  |                         |                          | 3.12                                | 3.21            | 3.31            | 3.41            | 3.65            |
| UDCLBF 2006-0400 |                       | 4                         |                      |                          |                       |                  |                         |                          | 4.15                                | 4.27            | 4.41            | 4.55            | 4.87            |
| UDCLBF 2006-0500 |                       | 5                         |                      |                          |                       |                  |                         |                          | 5.18                                | 5.34            | 5.51            | 5.69            | 6.09            |
| UDCLBF 2006-0600 | 6                     | 6.21                      | 6.40                 | 6.61                     | 6.83                  | 7.32             |                         |                          |                                     |                 |                 |                 |                 |
| UDCLBF 2008-0200 | R0.4                  | 2                         | 0.56                 | 0.76                     | 16°                   | 50               | 4                       | 38,900                   | 2.08                                | 2.14            | 2.20            | 2.26            | 2.40            |
| UDCLBF 2008-0300 |                       | 3                         |                      |                          |                       |                  |                         |                          | 3.11                                | 3.20            | 3.30            | 3.40            | 3.62            |
| UDCLBF 2008-0400 |                       | 4                         |                      |                          |                       |                  |                         |                          | 4.14                                | 4.27            | 4.40            | 4.54            | 4.85            |
| UDCLBF 2008-0500 |                       | 5                         |                      |                          |                       |                  |                         |                          | 5.18                                | 5.33            | 5.50            | 5.67            | 6.07            |
| UDCLBF 2008-0600 |                       | 6                         |                      |                          |                       |                  |                         |                          | 6.21                                | 6.40            | 6.60            | 6.81            | 7.29            |
| UDCLBF 2008-0800 |                       | 8                         |                      |                          |                       |                  |                         |                          | 8.27                                | 8.53            | 8.80            | 9.09            | 9.74            |
| UDCLBF 2010-0150 | R0.5                  | 1.5                       | 0.7                  | 0.96                     | 16°                   | 50               | 4                       | 38,900                   | 1.56                                | 1.60            | 1.64            | 1.68            | 1.77            |
| UDCLBF 2010-0200 |                       | 2                         |                      |                          |                       |                  |                         |                          | 2.08                                | 2.13            | 2.19            | 2.25            | 2.38            |
| UDCLBF 2010-0250 |                       | 2.5                       |                      |                          |                       |                  |                         |                          | 2.59                                | 2.66            | 2.74            | 2.81            | 2.99            |
| UDCLBF 2010-0300 |                       | 3                         |                      |                          |                       |                  |                         |                          | 3.11                                | 3.20            | 3.29            | 3.38            | 3.60            |
| UDCLBF 2010-0400 |                       | 4                         |                      |                          |                       |                  |                         |                          | 4.14                                | 4.26            | 4.39            | 4.52            | 4.83            |
| UDCLBF 2010-0600 |                       | 6                         |                      |                          |                       |                  |                         |                          | 6.20                                | 6.39            | 6.59            | 6.80            | 7.27            |
| UDCLBF 2010-0800 | 8                     | 8.27                      | 8.52                 | 8.79                     | 9.08                  | 9.72             |                         |                          |                                     |                 |                 |                 |                 |
| UDCLBF 2010-1000 | 10                    | 10.33                     | 10.65                | 10.99                    | 11.35                 | 12.17            |                         |                          |                                     |                 |                 |                 |                 |
| UDCLBF 2015-0200 | R0.75                 | 2                         | 1.05                 | 1.44                     | 16°                   | 50               | 4                       | 38,900                   | 2.11                                | 2.15            | 2.20            | 2.25            | 2.37            |
| UDCLBF 2015-0400 |                       | 4                         |                      |                          |                       |                  |                         |                          | 4.17                                | 4.28            | 4.40            | 4.53            | 4.81            |
| UDCLBF 2015-0600 |                       | 6                         |                      |                          |                       |                  |                         |                          | 6.23                                | 6.41            | 6.60            | 6.81            | 7.26            |
| UDCLBF 2015-0800 |                       | 8                         |                      |                          |                       |                  |                         |                          | 8.29                                | 8.54            | 8.80            | 9.08            | 9.71            |
| UDCLBF 2015-1000 |                       | 10                        |                      |                          |                       |                  |                         |                          | 10.36                               | 10.67           | 11.00           | 11.36           | 12.16           |
| UDCLBF 2015-1200 |                       | 12                        |                      |                          |                       |                  |                         |                          | 12.42                               | 12.80           | 13.20           | 13.64           | 14.60           |
| UDCLBF 2020-0300 | R1                    | 3                         | 1.4                  | 1.9                      | 16°                   | 50               | 4                       | 38,900                   | 3.20                                | 3.27            | 3.35            | 3.43            | 3.62            |
| UDCLBF 2020-0400 |                       | 4                         |                      |                          |                       |                  |                         |                          | 4.23                                | 4.34            | 4.45            | 4.57            | 4.84            |
| UDCLBF 2020-0600 |                       | 6                         |                      |                          |                       |                  |                         |                          | 6.30                                | 6.47            | 6.65            | 6.85            | 7.29            |
| UDCLBF 2020-0800 |                       | 8                         |                      |                          |                       |                  |                         |                          | 8.36                                | 8.60            | 8.85            | 9.13            | 9.74            |
| UDCLBF 2020-1000 |                       | 10                        |                      |                          |                       |                  |                         |                          | 10.42                               | 10.73           | 11.06           | 11.41           | 12.19           |
| UDCLBF 2020-1200 |                       | 12                        |                      |                          |                       |                  |                         |                          | 12.48                               | 12.86           | 13.26           | 13.68           | 14.63           |
| UDCLBF 2020-1400 |                       | 14                        |                      |                          |                       |                  |                         |                          | 14.55                               | 14.99           | 15.46           | 15.96           | 17.08           |
| UDCLBF 2020-1600 |                       | 16                        |                      |                          |                       |                  |                         |                          | 16.61                               | 17.12           | 17.66           | 18.24           | 19.53           |
| UDCLBF 2020-1800 |                       | 18                        |                      |                          |                       |                  |                         |                          | 18.67                               | 19.25           | 19.86           | 20.52           | No Interference |
| UDCLBF 2020-2000 |                       | 20                        |                      |                          |                       |                  |                         |                          | 20.74                               | 21.38           | 22.06           | 22.79           | No Interference |
| UDCLBF 2030-0600 | R1.5                  | 6                         | 2.1                  | 2.9                      | 16°                   | 60               | 6                       | 42,800                   | 6.28                                | 6.44            | 6.60            | 6.78            | 7.18            |
| UDCLBF 2030-0800 |                       | 8                         |                      |                          |                       |                  |                         |                          | 8.34                                | 8.57            | 8.80            | 9.06            | 9.63            |
| UDCLBF 2030-1000 |                       | 10                        |                      |                          |                       |                  |                         |                          | 10.41                               | 10.70           | 11.01           | 11.34           | 12.08           |
| UDCLBF 2030-1200 |                       | 12                        |                      |                          |                       |                  |                         |                          | 12.47                               | 12.83           | 13.21           | 13.61           | 14.52           |
| UDCLBF 2030-1400 |                       | 14                        |                      |                          |                       |                  |                         |                          | 14.53                               | 14.96           | 15.41           | 15.89           | 16.97           |
| UDCLBF 2040-0800 | R2                    | 8                         | 2.8                  | 3.9                      | 16°                   | 60               | 6                       | 42,800                   | 8.33                                | 8.53            | 8.76            | 8.99            | 9.52            |
| UDCLBF 2040-1000 |                       | 10                        |                      |                          |                       |                  |                         |                          | 10.39                               | 10.66           | 10.96           | 11.27           | 11.97           |
| UDCLBF 2040-1500 |                       | 15                        |                      |                          |                       |                  |                         |                          | 15.55                               | 15.99           | 16.46           | 16.96           | 18.09           |
| UDCLBF 2050-1000 | R2.5                  | 10                        | 3.5                  | 4.8                      | 16°                   | 60               | 6                       | 42,800                   | 10.55                               | 10.82           | 11.10           | 11.40           | 12.07           |
| UDCLBF 2050-1500 |                       | 15                        |                      |                          |                       |                  |                         |                          | 15.71                               | 16.14           | 16.60           | 17.09           | No Interference |
| UDCLBF 2060-1000 | R3                    | 10                        | 4.2                  | 5.7                      | —                     | 60               | 6                       | 42,800                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| UDCLBF 2060-1500 |                       | 15                        |                      |                          |                       |                  |                         |                          | No Interference                     | No Interference | No Interference | No Interference | No Interference |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for UDCLBF

| WORK MATERIAL |                          |                       | CEMENTED CARBIDE (≥87HRA) / HARD BRITTLE MATERIALS |                    |                        |                     |                     | CEMENTED CARBIDE (<87HRA)          |                    |                        |                     |                     |
|---------------|--------------------------|-----------------------|--|--------------------|------------------------|---------------------|---------------------|------------------------------------|--------------------|------------------------|---------------------|---------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                 | Feed Rate (mm/min) | **Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | **Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |
| 2002-0030     | R0.1                     | 0.3                   | 30,000   | 100                | 10                     | 0.01                | 0.01                | 30,000                             | 100                | 10                     | 0.01                | 0.01                |
| 2002-0050     |                          | 0.5                   | 30,000   | 30                 | 10                     | 0.005               | 0.008               | 30,000                             | 30                 | 10                     | 0.005               | 0.008               |
| 2002-0075     |                          | 0.75                  | 30,000   | 30                 | 10                     | 0.005               | 0.006               | 30,000                             | 30                 | 10                     | 0.005               | 0.006               |
| 2002-0100     |                          | 1                     | 30,000   | 25                 | 10                     | 0.005               | 0.005               | 30,000                             | 25                 | 10                     | 0.005               | 0.005               |
| 2003-0050     | R0.15                    | 0.5                   | 30,000   | 100                | 10                     | 0.01                | 0.03                | 30,000                             | 100                | 10                     | 0.01                | 0.03                |
| 2003-0075     |                          | 0.75                  | 30,000   | 80                 | 10                     | 0.01                | 0.02                | 30,000                             | 80                 | 10                     | 0.01                | 0.02                |
| 2003-0100     |                          | 1                     | 30,000   | 60                 | 10                     | 0.01                | 0.02                | 30,000                             | 60                 | 10                     | 0.01                | 0.02                |
| 2004-0050     | R0.2                     | 0.5                   | 30,000   | 150                | 15                     | 0.02                | 0.08                | 30,000                             | 150                | 15                     | 0.02                | 0.08                |
| 2004-0100     |                          | 1                     | 30,000   | 100                | 10                     | 0.015               | 0.07                | 30,000                             | 100                | 10                     | 0.015               | 0.07                |
| 2004-0150     |                          | 1.5                   | 30,000   | 60                 | 10                     | 0.01                | 0.06                | 30,000                             | 60                 | 10                     | 0.01                | 0.06                |
| 2004-0200     |                          | 2                     | 30,000   | 30                 | 10                     | 0.008               | 0.05                | 30,000                             | 30                 | 10                     | 0.008               | 0.05                |
| 2004-0250     |                          | 2.5                   | 30,000   | 15                 | 10                     | 0.006               | 0.03                | 30,000                             | 15                 | 10                     | 0.006               | 0.03                |
| 2006-0100     |                          | 1                     | 30,000   | 200                | 20                     | 0.03                | 0.14                | 30,000                             | 200                | 20                     | 0.03                | 0.14                |
| 2006-0150     | R0.3                     | 1.5                   | 30,000   | 200                | 20                     | 0.03                | 0.14                | 30,000                             | 200                | 20                     | 0.03                | 0.14                |
| 2006-0200     |                          | 2                     | 30,000   | 150                | 15                     | 0.022               | 0.11                | 30,000                             | 150                | 15                     | 0.022               | 0.11                |
| 2006-0300     |                          | 3                     | 30,000   | 75                 | 10                     | 0.01                | 0.08                | 30,000                             | 75                 | 10                     | 0.01                | 0.08                |
| 2006-0400     |                          | 4                     | 30,000   | 75                 | 10                     | 0.01                | 0.08                | 30,000                             | 75                 | 10                     | 0.01                | 0.08                |
| 2006-0500     |                          | 5                     | 30,000   | 75                 | 10                     | 0.01                | 0.06                | 30,000                             | 75                 | 10                     | 0.01                | 0.06                |
| 2006-0600     |                          | 6                     | 30,000   | 75                 | 10                     | 0.01                | 0.03                | 30,000                             | 75                 | 10                     | 0.01                | 0.03                |
| 2008-0200     | R0.4                     | 2                     | 30,000   | 250                | 25                     | 0.04                | 0.19                | 30,000                             | 250                | 25                     | 0.04                | 0.19                |
| 2008-0300     |                          | 3                     | 30,000   | 230                | 23                     | 0.037               | 0.17                | 30,000                             | 230                | 23                     | 0.037               | 0.17                |
| 2008-0400     |                          | 4                     | 30,000   | 210                | 21                     | 0.035               | 0.16                | 30,000                             | 210                | 21                     | 0.035               | 0.16                |
| 2008-0500     |                          | 5                     | 25,000   | 170                | 20                     | 0.03                | 0.12                | 25,000                             | 170                | 20                     | 0.03                | 0.12                |
| 2008-0600     |                          | 6                     | 20,000   | 130                | 20                     | 0.025               | 0.08                | 20,000                             | 130                | 20                     | 0.025               | 0.08                |
| 2008-0800     | R0.5                     | 8                     | 15,000   | 100                | 20                     | 0.015               | 0.03                | 15,000                             | 100                | 20                     | 0.015               | 0.03                |
| 2010-0150     |                          | 1.5                   | 30,000   | 300                | 30                     | 0.05                | 0.25                | 30,000                             | 300                | 150                    | 0.35                | 0.075               |
| 2010-0200     |                          | 2                     | 30,000   | 300                | 30                     | 0.05                | 0.25                | 30,000                             | 300                | 150                    | 0.35                | 0.075               |
| 2010-0250     |                          | 2.5                   | 30,000   | 300                | 30                     | 0.05                | 0.25                | 30,000                             | 300                | 150                    | 0.35                | 0.075               |
| 2010-0300     |                          | 3                     | 30,000   | 300                | 30                     | 0.05                | 0.25                | 25,000                             | 250                | 125                    | 0.35                | 0.075               |
| 2010-0400     | 4                        | 30,000                | 300  | 30                 | 0.05                   | 0.25                | 25,000              | 250                                | 125                | 0.2                    | 0.1                 |                     |
| 2010-0600     | R0.75                    | 6                     | 25,000   | 250                | 25                     | 0.04                | 0.15                | 25,000                             | 250                | 125                    | 0.1                 | 0.1                 |
| 2010-0800     |                          | 8                     | 20,000   | 200                | 25                     | 0.025               | 0.07                | 20,000                             | 200                | 100                    | 0.03                | 0.08                |
| 2010-1000     |                          | 10                    | 10,000   | 100                | 20                     | 0.018               | 0.03                | 20,000                             | 200                | 100                    | 0.02                | 0.04                |
| 2015-0200     |                          | 2                     | 25,000   | 250                | 45                     | 0.075               | 0.27                | 18,000                             | 180                | 90                     | 0.52                | 0.12                |
| 2015-0400     |                          | 4                     | 25,000   | 250                | 45                     | 0.075               | 0.27                | 18,000                             | 180                | 90                     | 0.52                | 0.12                |
| 2015-0600     | R1                       | 6                     | 25,000   | 250                | 45                     | 0.075               | 0.27                | 18,000                             | 180                | 90                     | 0.4                 | 0.12                |
| 2015-0800     |                          | 8                     | 20,000   | 160                | 30                     | 0.075               | 0.27                | 18,000                             | 180                | 90                     | 0.2                 | 0.2                 |
| 2015-1000     |                          | 10                    | 20,000   | 130                | 30                     | 0.05                | 0.15                | 18,000                             | 180                | 90                     | 0.075               | 0.25                |
| 2015-1200     |                          | 12                    | 16,000   | 100                | 30                     | 0.03                | 0.08                | 13,500                             | 135                | 70                     | 0.05                | 0.16                |
| 2020-0300     |                          | 3                     | 20,000   | 200                | 60                     | 0.1                 | 0.3                 | 12,500                             | 125                | 60                     | 0.7                 | 0.15                |
| 2020-0400     | 4                        | 20,000                | 200  | 60                 | 0.1                    | 0.3                 | 12,500              | 125                                | 60                 | 0.7                    | 0.15                |                     |
| 2020-0600     | 6                        | 20,000                | 200  | 60                 | 0.1                    | 0.3                 | 12,500              | 125                                | 60                 | 0.7                    | 0.15                |                     |
| 2020-0800     | 8                        | 20,000                | 200  | 60                 | 0.1                    | 0.3                 | 12,500              | 125                                | 60                 | 0.4                    | 0.2                 |                     |
| 2020-1000     | 10                       | 20,000                | 200  | 60                 | 0.1                    | 0.3                 | 12,500              | 125                                | 60                 | 0.25                   | 0.25                |                     |
| 2020-1200     | 12                       | 20,000                | 200  | 60                 | 0.09                   | 0.25                | 12,500              | 125                                | 60                 | 0.1                    | 0.3                 |                     |
| 2020-1400     | 14                       | 20,000                | 200  | 60                 | 0.07                   | 0.15                | 12,500              | 125                                | 60                 | 0.1                    | 0.3                 |                     |
| 2020-1600     | 16                       | 13,000                | 130  | 36                 | 0.04                   | 0.08                | 12,500              | 125                                | 60                 | 0.1                    | 0.3                 |                     |
| 2020-1800     | 18                       | 10,000                | 100  | 30                 | 0.025                  | 0.05                | 10,000              | 100                                | 50                 | 0.04                   | 0.1                 |                     |
| 2020-2000     | 20                       | 10,000                | 100  | 30                 | 0.02                   | 0.035               | 10,000              | 100                                | 50                 | 0.02                   | 0.07                |                     |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

## Milling Conditions for UDCLBF

| WORK MATERIAL |                          |                       | CEMENTED CARBIDE (≥87HRA) / HARD BRITTLE MATERIALS |                    |                       |            |            | CEMENTED CARBIDE (<87HRA)          |                    |                       |            |            |
|---------------|--------------------------|-----------------------|--|--------------------|-----------------------|------------|------------|------------------------------------|--------------------|-----------------------|------------|------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                 | Feed Rate (mm/min) | *Feed Rate 2 (mm/min) | $a_e$ (mm) | $a_e$ (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | *Feed Rate 2 (mm/min) | $a_e$ (mm) | $a_e$ (mm) |
| 2030-0600     | R1.5                     | 6                     | 20,000   | 200                | 100                   | 0.15       | 0.3        | 9,000                              | 280                | 140                   | 0.38       | 0.15       |
| 2030-0800     |                          | 8                     | 20,000   | 200                | 100                   | 0.15       | 0.3        | 9,000                              | 280                | 140                   | 0.38       | 0.15       |
| 2030-1000     |                          | 10                    | 20,000   | 200                | 100                   | 0.15       | 0.3        | 9,000                              | 280                | 140                   | 0.38       | 0.15       |
| 2030-1200     |                          | 12                    | 20,000   | 200                | 100                   | 0.15       | 0.3        | 9,000                              | 280                | 140                   | 0.38       | 0.15       |
| 2030-1400     |                          | 14                    | 20,000   | 200                | 100                   | 0.15       | 0.3        | 9,000                              | 280                | 140                   | 0.38       | 0.15       |
| 2040-0800     | R2                       | 8                     | 18,000   | 180                | 90                    | 0.175      | 0.32       | 7,200                              | 280                | 140                   | 0.5        | 0.2        |
| 2040-1000     |                          | 10                    | 18,000   | 180                | 90                    | 0.175      | 0.32       | 7,200                              | 280                | 140                   | 0.5        | 0.2        |
| 2040-1500     |                          | 15                    | 18,000   | 180                | 90                    | 0.175      | 0.32       | 7,200                              | 280                | 140                   | 0.5        | 0.2        |
| 2050-1000     | R2.5                     | 10                    | 16,000   | 160                | 80                    | 0.225      | 0.31       | 6,000                              | 330                | 170                   | 0.6        | 0.25       |
| 2050-1500     |                          | 15                    | 16,000   | 160                | 80                    | 0.225      | 0.31       | 6,000                              | 330                | 170                   | 0.6        | 0.25       |
| 2060-1000     | R3                       | 10                    | 15,000   | 150                | 75                    | 0.3        | 0.3        | 5,500                              | 280                | 140                   | 0.65       | 0.28       |
| 2060-1500     |                          | 15                    | 15,000   | 150                | 75                    | 0.3        | 0.3        | 5,500                              | 280                | 140                   | 0.65       | 0.28       |

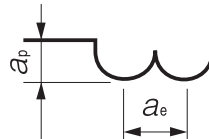
These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (TAS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only.

Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials.

For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

\* Feed Rate2: Feed rate of approach and \*connection moves.

\*Changing from one engagement point to the next.



### Note:

- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Use an inclined or helical approach (Recommended inclination angle: <5 degree).
- Decrease both spindle speed and feed rate proportionally.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.1~R3



**UDCLB**



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           |                 |          |        | ○<br>*1  |                       |                 | ★                     | ●<br>*2          |                                       |

\*1 DCB/DCLB series are highly recommended for Glass Filled Plastic milling.  
 \*2 Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

Total 37 models

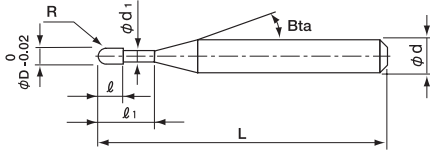
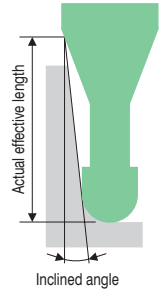
Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi_d$ | Shank Taper Angle Bfa | Overall Length L | Shank Diameter $\phi_d$ | Suggested Retail Price ¥ |
|-----------------|-----------------------|---------------------------|----------------------|------------------------|-----------------------|------------------|-------------------------|--------------------------|
| UDCLB 2002-0030 | R0.1                  | 0.3                       | 0.14                 | 0.18                   | 16°                   | 50               | 4                       | 39,580                   |
| UDCLB 2002-0050 |                       | 0.5                       |                      |                        |                       | 50               | 4                       | 39,580                   |
| UDCLB 2002-0075 |                       | 0.75                      |                      |                        |                       | 50               | 4                       | 39,580                   |
| UDCLB 2002-0100 | R0.2                  | 1                         | 0.28                 | 0.36                   | 16°                   | 50               | 4                       | 39,580                   |
| UDCLB 2004-0050 |                       | 0.5                       |                      |                        |                       | 50               | 4                       | 36,080                   |
| UDCLB 2004-0100 |                       | 1                         |                      |                        |                       | 50               | 4                       | 36,080                   |
| UDCLB 2004-0150 |                       | 1.5                       |                      |                        |                       | 50               | 4                       | 36,080                   |
| UDCLB 2004-0200 | R0.3                  | 2                         | 0.42                 | 0.56                   | 16°                   | 50               | 4                       | 36,080                   |
| UDCLB 2006-0100 |                       | 1                         |                      |                        |                       | 50               | 4                       | 32,410                   |
| UDCLB 2006-0150 |                       | 1.5                       |                      |                        |                       | 50               | 4                       | 32,410                   |
| UDCLB 2006-0200 | R0.4                  | 2                         | 0.56                 | 0.76                   | 16°                   | 50               | 4                       | 32,410                   |
| UDCLB 2006-0300 |                       | 3                         |                      |                        |                       | 50               | 4                       | 32,410                   |
| UDCLB 2008-0200 |                       | 2                         |                      |                        |                       | 50               | 4                       | 32,410                   |
| UDCLB 2008-0300 |                       | 3                         |                      |                        |                       | 50               | 4                       | 32,410                   |
| UDCLB 2008-0400 | R0.5                  | 4                         | 0.7                  | 0.96                   | 16°                   | 50               | 4                       | 32,410                   |
| UDCLB 2010-0200 |                       | 2                         |                      |                        |                       | 50               | 4                       | 32,410                   |
| UDCLB 2010-0250 |                       | 2.5                       |                      |                        |                       | 50               | 4                       | 32,410                   |
| UDCLB 2010-0300 |                       | 3                         |                      |                        |                       | 50               | 4                       | 32,410                   |
| UDCLB 2010-0400 |                       | 4                         |                      |                        |                       | 50               | 4                       | 32,410                   |
| UDCLB 2010-0500 | R1                    | 5                         | 1.4                  | 1.9                    | 16°                   | 50               | 4                       | 32,410                   |
| UDCLB 2020-0300 |                       | 3                         |                      |                        |                       | 50               | 4                       | 32,410                   |
| UDCLB 2020-0400 |                       | 4                         |                      |                        |                       | 50               | 4                       | 32,410                   |
| UDCLB 2020-0600 |                       | 6                         |                      |                        |                       | 50               | 4                       | 32,410                   |
| UDCLB 2020-0800 | R1.5                  | 8                         | 2.1                  | 2.9                    | 16°                   | 50               | 4                       | 32,410                   |
| UDCLB 2020-1000 |                       | 10                        |                      |                        |                       | 60               | 6                       | 35,580                   |
| UDCLB 2030-0600 |                       | 6                         |                      |                        |                       | 60               | 6                       | 35,580                   |
| UDCLB 2030-0800 | R2                    | 8                         | 2.8                  | 3.9                    | 16°                   | 60               | 6                       | 35,580                   |
| UDCLB 2030-1000 |                       | 10                        |                      |                        |                       | 60               | 6                       | 35,580                   |
| UDCLB 2030-1200 |                       | 12                        |                      |                        |                       | 60               | 6                       | 35,580                   |
| UDCLB 2030-1400 |                       | 14                        |                      |                        |                       | 60               | 6                       | 35,580                   |
| UDCLB 2040-0800 | R2.5                  | 8                         | 3.5                  | 4.8                    | 16°                   | 60               | 6                       | 35,580                   |
| UDCLB 2040-1000 |                       | 10                        |                      |                        |                       | 60               | 6                       | 35,580                   |
| UDCLB 2040-1500 |                       | 15                        |                      |                        |                       | 60               | 6                       | 35,580                   |
| UDCLB 2050-1000 | R3                    | 10                        | 4.2                  | 5.7                    | —                     | 60               | 6                       | 35,580                   |
| UDCLB 2050-1500 |                       | 15                        |                      |                        |                       | 60               | 6                       | 35,580                   |
| UDCLB 2060-1000 |                       | 10                        |                      |                        |                       | 60               | 6                       | 35,580                   |
| UDCLB 2060-1500 |                       | 15                        |                      |                        |                       | 60               | 6                       | 35,580                   |



**Features**

Long Neck Ball type End Mills for milling Cemented Carbide and Hard Brittle (Non-Metallic) Materials. Developed to give improved hardness and durability, new Diamond coating also has outstanding adhesion to the cutting tool. By combining the new coating with optimum cutting geometries, the tool "deep cuts" the work piece. Leaves a burr and pit free surface finish on semi-roughing & finishing process.



Label Sample



#001 φD1.985 R+0.001/-0.002

Diameter and Ball R accuracy measurements are printed on the label to support High Precision milling.

The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length ℓ <sub>1</sub> | Effective Length by Inclined Angles |                 |                 |                 |                 |
|-----------------|-----------------------|---------------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|                 |                       |                                 | 30°                                 | 1°              | 1°30'           | 2°              | 3°              |
| UDCLB 2002-0030 | RO.1                  | 0.3                             | 0.30                                | 0.31            | 0.32            | 0.32            | 0.34            |
| UDCLB 2002-0050 |                       | 0.5                             | 0.51                                | 0.52            | 0.54            | 0.55            | 0.59            |
| UDCLB 2002-0075 |                       | 0.75                            | 0.77                                | 0.79            | 0.81            | 0.84            | 0.89            |
| UDCLB 2002-0100 | RO.2                  | 1                               | 1.02                                | 1.05            | 1.09            | 1.12            | 1.20            |
| UDCLB 2004-0050 |                       | 0.5                             | 0.54                                | 0.55            | 0.56            | 0.58            | 0.61            |
| UDCLB 2004-0100 |                       | 1                               | 1.06                                | 1.08            | 1.12            | 1.15            | 1.22            |
| UDCLB 2004-0150 | RO.2                  | 1.5                             | 1.57                                | 1.62            | 1.67            | 1.72            | 1.83            |
| UDCLB 2004-0200 |                       | 2                               | 2.09                                | 2.15            | 2.22            | 2.29            | 2.44            |
| UDCLB 2006-0100 |                       | 1                               | 1.05                                | 1.08            | 1.11            | 1.13            | 1.20            |
| UDCLB 2006-0150 | RO.3                  | 1.5                             | 1.57                                | 1.61            | 1.66            | 1.70            | 1.81            |
| UDCLB 2006-0200 |                       | 2                               | 2.08                                | 2.14            | 2.21            | 2.27            | 2.42            |
| UDCLB 2006-0300 |                       | 3                               | 3.12                                | 3.21            | 3.31            | 3.41            | 3.65            |
| UDCLB 2008-0200 | RO.4                  | 2                               | 2.08                                | 2.14            | 2.20            | 2.26            | 2.40            |
| UDCLB 2008-0300 |                       | 3                               | 3.11                                | 3.20            | 3.30            | 3.40            | 3.62            |
| UDCLB 2008-0400 |                       | 4                               | 4.14                                | 4.27            | 4.40            | 4.54            | 4.85            |
| UDCLB 2010-0200 | RO.5                  | 2                               | 2.08                                | 2.13            | 2.19            | 2.25            | 2.38            |
| UDCLB 2010-0250 |                       | 2.5                             | 2.59                                | 2.66            | 2.74            | 2.81            | 2.99            |
| UDCLB 2010-0300 |                       | 3                               | 3.11                                | 3.20            | 3.29            | 3.38            | 3.60            |
| UDCLB 2010-0400 | R1                    | 4                               | 4.14                                | 4.26            | 4.39            | 4.52            | 4.83            |
| UDCLB 2010-0500 |                       | 5                               | 5.17                                | 5.32            | 5.49            | 5.66            | 6.05            |
| UDCLB 2020-0300 |                       | 3                               | 3.20                                | 3.27            | 3.35            | 3.43            | 3.62            |
| UDCLB 2020-0400 | R1                    | 4                               | 4.23                                | 4.34            | 4.45            | 4.57            | 4.84            |
| UDCLB 2020-0600 |                       | 6                               | 6.30                                | 6.47            | 6.65            | 6.85            | 7.29            |
| UDCLB 2020-0800 |                       | 8                               | 8.36                                | 8.60            | 8.85            | 9.13            | 9.74            |
| UDCLB 2020-1000 | R1.5                  | 10                              | 10.42                               | 10.73           | 11.06           | 11.41           | 12.19           |
| UDCLB 2030-0600 |                       | 6                               | 6.28                                | 6.44            | 6.60            | 6.78            | 7.18            |
| UDCLB 2030-0800 |                       | 8                               | 8.34                                | 8.57            | 8.80            | 9.06            | 9.63            |
| UDCLB 2030-1000 | R1.5                  | 10                              | 10.41                               | 10.70           | 11.01           | 11.34           | 12.08           |
| UDCLB 2030-1200 |                       | 12                              | 12.47                               | 12.83           | 13.21           | 13.61           | 14.52           |
| UDCLB 2030-1400 |                       | 14                              | 14.53                               | 14.96           | 15.41           | 15.89           | 16.97           |
| UDCLB 2040-0800 | R2                    | 8                               | 8.33                                | 8.53            | 8.76            | 8.99            | 9.52            |
| UDCLB 2040-1000 |                       | 10                              | 10.39                               | 10.66           | 10.96           | 11.27           | 11.97           |
| UDCLB 2040-1500 |                       | 15                              | 15.55                               | 15.99           | 16.46           | 16.96           | 18.09           |
| UDCLB 2050-1000 | R2.5                  | 10                              | 10.55                               | 10.82           | 11.10           | 11.40           | 12.07           |
| UDCLB 2050-1500 |                       | 15                              | 15.71                               | 16.14           | 16.60           | 17.09           | No Interference |
| UDCLB 2060-1000 | R3                    | 10                              | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| UDCLB 2060-1500 |                       | 15                              | No Interference                     | No Interference | No Interference | No Interference | No Interference |

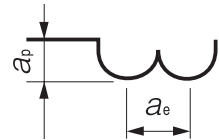
- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Square Long Neck Square
- Radius
- Radius Long Neck Radius
- Radius Taper Neck Radius
- Ball
- Ball / Long Shank Ball
- Ball Long Neck Ball
- Ball Taper Neck Ball
- Taper
- Taper Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Milling Conditions for UDCLB

| WORK MATERIAL |                          |                       | CEMENTED CARBIDE (≥87HRA)          |                    |                       |                     |                     | CEMENTED CARBIDE (<87HRA)          |                    |                       |                     |                     | HARD BRITTLE MATERIALS             |                    |                       |                     |                     |
|---------------|--------------------------|-----------------------|------------------------------------|--------------------|-----------------------|---------------------|---------------------|------------------------------------|--------------------|-----------------------|---------------------|---------------------|------------------------------------|--------------------|-----------------------|---------------------|---------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | ※Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | ※Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | ※Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |
| 2002-0030     | R0.1                     | 0.3                   | 30,000                             | 100                | 10                    | 0.01                | 0.01                | 30,000                             | 100                | 10                    | 0.01                | 0.01                | 30,000                             | 100                | 10                    | 0.01                | 0.01                |
| 2002-0050     |                          | 0.5                   | 30,000                             | 30                 | 10                    | 0.005               | 0.008               | 30,000                             | 30                 | 10                    | 0.005               | 0.008               | 30,000                             | 30                 | 10                    | 0.005               | 0.008               |
| 2002-0075     |                          | 0.75                  | 30,000                             | 30                 | 10                    | 0.005               | 0.006               | 30,000                             | 30                 | 10                    | 0.005               | 0.006               | 30,000                             | 30                 | 10                    | 0.005               | 0.006               |
| 2002-0100     | R0.2                     | 1                     | 30,000                             | 25                 | 10                    | 0.005               | 0.005               | 30,000                             | 25                 | 10                    | 0.005               | 0.005               | 30,000                             | 25                 | 10                    | 0.005               | 0.005               |
| 2004-0050     |                          | 0.5                   | 30,000                             | 150                | 15                    | 0.02                | 0.08                | 30,000                             | 150                | 15                    | 0.02                | 0.08                | 30,000                             | 150                | 15                    | 0.02                | 0.08                |
| 2004-0100     |                          | 1                     | 30,000                             | 100                | 10                    | 0.015               | 0.07                | 30,000                             | 100                | 10                    | 0.015               | 0.07                | 30,000                             | 100                | 10                    | 0.015               | 0.07                |
| 2004-0150     | R0.3                     | 1.5                   | 30,000                             | 60                 | 10                    | 0.01                | 0.06                | 30,000                             | 60                 | 10                    | 0.01                | 0.06                | 30,000                             | 60                 | 10                    | 0.01                | 0.06                |
| 2004-0200     |                          | 2                     | 30,000                             | 30                 | 10                    | 0.008               | 0.05                | 30,000                             | 30                 | 10                    | 0.008               | 0.05                | 30,000                             | 30                 | 10                    | 0.008               | 0.05                |
| 2006-0100     |                          | 1                     | 30,000                             | 200                | 20                    | 0.03                | 0.14                | 30,000                             | 200                | 20                    | 0.03                | 0.14                | 30,000                             | 200                | 20                    | 0.03                | 0.14                |
| 2006-0150     | R0.4                     | 1.5                   | 30,000                             | 200                | 20                    | 0.03                | 0.14                | 30,000                             | 200                | 20                    | 0.03                | 0.14                | 30,000                             | 200                | 20                    | 0.03                | 0.14                |
| 2006-0200     |                          | 2                     | 30,000                             | 150                | 15                    | 0.022               | 0.11                | 30,000                             | 150                | 15                    | 0.022               | 0.11                | 30,000                             | 150                | 15                    | 0.022               | 0.11                |
| 2006-0300     |                          | 3                     | 30,000                             | 75                 | 10                    | 0.01                | 0.08                | 30,000                             | 75                 | 10                    | 0.01                | 0.08                | 30,000                             | 75                 | 10                    | 0.01                | 0.08                |
| 2008-0200     | R0.5                     | 2                     | 30,000                             | 250                | 25                    | 0.04                | 0.19                | 30,000                             | 250                | 25                    | 0.04                | 0.19                | 30,000                             | 250                | 25                    | 0.04                | 0.19                |
| 2008-0300     |                          | 3                     | 30,000                             | 230                | 23                    | 0.037               | 0.17                | 30,000                             | 230                | 23                    | 0.037               | 0.17                | 30,000                             | 230                | 23                    | 0.037               | 0.17                |
| 2008-0400     |                          | 4                     | 30,000                             | 210                | 21                    | 0.035               | 0.16                | 30,000                             | 210                | 21                    | 0.035               | 0.16                | 30,000                             | 210                | 21                    | 0.035               | 0.16                |
| 2010-0200     | R0.6                     | 2                     | 30,000                             | 300                | 30                    | 0.05                | 0.25                | 20,000                             | 400                | 200                   | 0.35                | 0.075               | 30,000                             | 300                | 30                    | 0.05                | 0.25                |
| 2010-0250     |                          | 2.5                   | 30,000                             | 300                | 30                    | 0.05                | 0.25                | 20,000                             | 400                | 200                   | 0.35                | 0.075               | 30,000                             | 300                | 30                    | 0.05                | 0.25                |
| 2010-0300     |                          | 3                     | 30,000                             | 300                | 30                    | 0.05                | 0.25                | 20,000                             | 400                | 200                   | 0.35                | 0.075               | 30,000                             | 300                | 30                    | 0.05                | 0.25                |
| 2010-0400     | R0.7                     | 4                     | 30,000                             | 300                | 30                    | 0.05                | 0.25                | 20,000                             | 400                | 200                   | 0.3                 | 0.07                | 30,000                             | 300                | 30                    | 0.05                | 0.25                |
| 2010-0500     |                          | 5                     | 30,000                             | 300                | 30                    | 0.05                | 0.25                | 20,000                             | 400                | 200                   | 0.3                 | 0.07                | 30,000                             | 300                | 30                    | 0.05                | 0.25                |
| 2020-0300     |                          | 3                     | 30,000                             | 300                | 100                   | 0.1                 | 0.3                 | 16,500                             | 420                | 210                   | 0.25                | 0.1                 | 24,000                             | 240                | 100                   | 0.1                 | 0.3                 |
| 2020-0400     | R1                       | 4                     | 30,000                             | 300                | 100                   | 0.1                 | 0.3                 | 16,500                             | 420                | 210                   | 0.25                | 0.1                 | 24,000                             | 240                | 100                   | 0.1                 | 0.3                 |
| 2020-0600     |                          | 6                     | 30,000                             | 300                | 100                   | 0.1                 | 0.3                 | 16,500                             | 420                | 210                   | 0.25                | 0.1                 | 24,000                             | 240                | 100                   | 0.1                 | 0.3                 |
| 2020-0800     |                          | 8                     | 30,000                             | 300                | 100                   | 0.1                 | 0.3                 | 16,500                             | 420                | 210                   | 0.25                | 0.1                 | 24,000                             | 240                | 100                   | 0.1                 | 0.3                 |
| 2020-1000     | R1.5                     | 10                    | 30,000                             | 300                | 100                   | 0.1                 | 0.3                 | 16,500                             | 420                | 210                   | 0.25                | 0.1                 | 24,000                             | 240                | 100                   | 0.1                 | 0.3                 |
| 2030-0600     |                          | 6                     | 27,500                             | 275                | 140                   | 0.125               | 0.33                | 11,000                             | 280                | 140                   | 0.38                | 0.15                | 24,000                             | 240                | 120                   | 0.125               | 0.33                |
| 2030-0800     |                          | 8                     | 27,500                             | 275                | 140                   | 0.125               | 0.33                | 11,000                             | 280                | 140                   | 0.38                | 0.15                | 24,000                             | 240                | 120                   | 0.125               | 0.33                |
| 2030-1000     | R2                       | 10                    | 27,500                             | 275                | 140                   | 0.125               | 0.33                | 11,000                             | 280                | 140                   | 0.3                 | 0.15                | 24,000                             | 240                | 120                   | 0.125               | 0.33                |
| 2030-1200     |                          | 12                    | 27,500                             | 220                | 110                   | 0.125               | 0.33                | 11,000                             | 280                | 140                   | 0.3                 | 0.15                | 24,000                             | 200                | 100                   | 0.125               | 0.33                |
| 2030-1400     |                          | 14                    | 27,500                             | 220                | 110                   | 0.125               | 0.33                | 11,000                             | 280                | 140                   | 0.3                 | 0.15                | 24,000                             | 200                | 100                   | 0.125               | 0.33                |
| 2040-0800     | R2.5                     | 8                     | 24,000                             | 240                | 120                   | 0.15                | 0.35                | 8,250                              | 300                | 150                   | 0.5                 | 0.2                 | 24,000                             | 240                | 120                   | 0.15                | 0.35                |
| 2040-1000     |                          | 10                    | 24,000                             | 240                | 120                   | 0.15                | 0.35                | 8,250                              | 300                | 150                   | 0.5                 | 0.2                 | 24,000                             | 240                | 120                   | 0.15                | 0.35                |
| 2040-1500     |                          | 15                    | 24,000                             | 240                | 120                   | 0.15                | 0.35                | 8,250                              | 300                | 150                   | 0.5                 | 0.2                 | 24,000                             | 240                | 120                   | 0.15                | 0.35                |
| 2050-1000     | R3                       | 10                    | 22,000                             | 220                | 110                   | 0.175               | 0.37                | 6,600                              | 330                | 160                   | 0.6                 | 0.25                | 22,000                             | 220                | 110                   | 0.175               | 0.37                |
| 2050-1500     |                          | 15                    | 22,000                             | 220                | 110                   | 0.175               | 0.37                | 6,600                              | 330                | 160                   | 0.6                 | 0.25                | 22,000                             | 220                | 110                   | 0.175               | 0.37                |
| 2060-1000     |                          | 10                    | 20,000                             | 200                | 100                   | 0.2                 | 0.4                 | 5,500                              | 280                | 140                   | 0.65                | 0.28                | 20,000                             | 200                | 100                   | 0.2                 | 0.4                 |
| 2060-1500     |                          | 15                    | 20,000                             | 200                | 100                   | 0.2                 | 0.4                 | 5,500                              | 280                | 140                   | 0.65                | 0.28                | 20,000                             | 200                | 100                   | 0.2                 | 0.4                 |

These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (TAS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only. Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials. For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

※ Feed Rate2: Feed rate of approach and \*connection moves.  
\*Changing from one engagement point to the next.

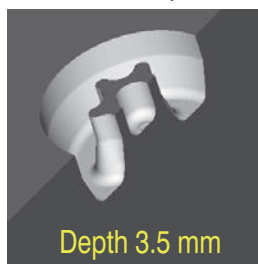


Note:

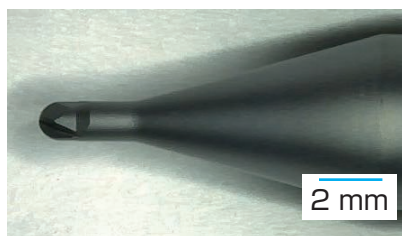
- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Use an inclined or helical approach (Recommended inclination angle: <5 degree).
- Decrease both spindle speed and feed rate proportionally.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

## Cemented Carbide Hexalobular milled with UDCLB R0.5 x EL2

VF-20 (92.5HRA)

Size:  $\phi 9$  x Depth 3.5 mm

|                         |  |
|-------------------------|--|
| Tool                    | UDCLB 2010-0200 (R0.5 x 2 mm)                          |
| Spindle Speed           | $n=30,000 \text{ min}^{-1}$                            |
| Feed Rate               | $V_f=300 \text{ mm/min}$                               |
| $a_p$                   | 0.05 mm  |
| $a_e$                   | 0.30 mm (Bottom Surface 0.05 mm)                       |
| Coolant                 | Air Blow   |
| Cycle Time              | 64.5 min   |
| Material Removal Amount | $164.6 \text{ mm}^3$<br>$2.57 \text{ mm}^3/\text{min}$ |

UDCLB  
Hexalobular  
Milling Video

## Cemented Carbide Hexalobular milled with UDCLB R0.5

VF-20 (92.5HRA)

Size:  
 $\phi 9$  x Depth 6 mm

|                         |  |
|-------------------------|--|
| Tool                    | UDCLB 2010-0200 (R0.5 x 2 mm)<br>UDCLB 2010-0500 (R0.5 x 5 mm)   |
| Spindle Speed           | $n=30,000 \text{ min}^{-1}$  |
| Feed Rate               | $V_f=300 \text{ mm/min}$   |
| Milling Amount          | 1. R0.5 x 2 Roughing (~Depth 3.5 mm)<br>$a_p=0.05 \text{ mm}$ $a_e=0.3 \text{ mm}$<br>2. R0.5 x 5 Roughing (~Depth 6 mm)<br>$a_p=0.05 \text{ mm}$ $a_e=0.25 \text{ mm}$<br>3. R0.5 x 5 Finishing<br>$a_p=0.03 \text{ mm}$ $a_e=0.005 \text{ mm}$ |
| Coolant                 | Air Blow   |
| Cycle Time              | 156 min  |
| Material Removal Amount | $274.4 \text{ mm}^3$   |



Tool #1 milled depth 3.5 mm.

Tool #2 milled  $131.9 \text{ mm}^3$  in 76.5 minutes. $\phi 3$ mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
RadiusTaper Neck  
Radius

Radius

Ball / Long  
Shank Ball

Ball

Long Neck  
BallTaper Neck  
Ball

Ball

Taper

Taper

Barrel

Barrel

Spiral  
V CutterSpiral  
V Cutter

Drill

Drill

Technical Data

Technical Data



Size R0.1~R1

# UPDLB



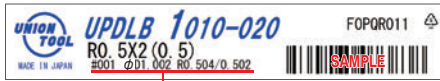
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 | ★                     | ●                |                                       |

## Features

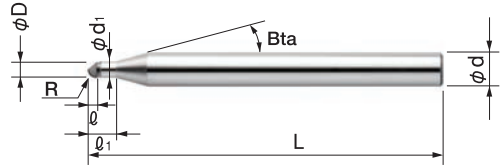
**Long Neck Ball type End Mills for finishing of Cemented Carbide and Hard Brittle Materials.**  
 Provides excellent machined surface quality due to the sharp cutting edge and optimized edge treatment.  
 Maintains excellent dimensional accuracy for a long time due to the high contour accuracy of the cutting edge and the excellent wear resistance of diamonds.

Label Sample



#001  $\phi D1.002$  R0.504/0.502

Diameter and Ball R accuracy measurements are printed on the label to support high precision milling.



Be sure to confirm the interference between the inclined work piece and the shank part by actual measurement.

Total 5 models

Unit (mm)

| Model Number   | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| UPDLB 1002-004 | R0.1                  | 0.4                       | 0.1                  | 0.18                     | 16°                   | 40               | 4                       | Open price               |
| UPDLB 1004-008 | R0.2                  | 0.8                       | 0.2                  | 0.38                     | 16°                   | 40               | 4                       | Open price               |
| UPDLB 1006-010 | R0.3                  | 1                         | 0.3                  | 0.58                     | 16°                   | 40               | 4                       | Open price               |
| UPDLB 1010-020 | R0.5                  | 2                         | 0.5                  | 0.95                     | 16°                   | 40               | 4                       | Open price               |
| UPDLB 1020-030 | R1                    | 3                         | 1                    | 1.95                     | 16°                   | 40               | 4                       | Open price               |

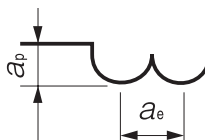
## Milling Conditions for UPDLB

For finishing of bottom surface

| WORK MATERIAL |                          |                       | CEMENTED CARBIDE                   |                    |            |            |
|---------------|--------------------------|-----------------------|------------------------------------|--------------------|------------|------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) |
| 1002-004      | R0.1                     | 0.4                   | 40,000                             | 100                | 0.001      | 0.001      |
| 1004-008      | R0.2                     | 0.8                   | 40,000                             | 150                | 0.001      | 0.001      |
| 1006-010      | R0.3                     | 1                     | 40,000                             | 200                | 0.001      | 0.001      |
| 1010-020      | R0.5                     | 2                     | 40,000                             | 400                | 0.001      | 0.003      |
| 1020-030      | R1                       | 3                     | 40,000                             | 600                | 0.001      | 0.005      |

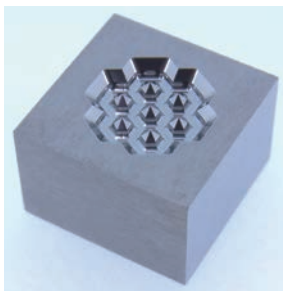
For Profile milling

| WORK MATERIAL |                          |                       | CEMENTED CARBIDE                   |                    |            |            |
|---------------|--------------------------|-----------------------|------------------------------------|--------------------|------------|------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) |
| 1002-004      | R0.1                     | 0.4                   | 40,000                             | 100                | 0.001      | 0.001      |
| 1004-008      | R0.2                     | 0.8                   | 40,000                             | 150                | 0.002      | 0.001      |
| 1006-010      | R0.3                     | 1                     | 40,000                             | 200                | 0.003      | 0.001      |
| 1010-020      | R0.5                     | 2                     | 40,000                             | 400                | 0.005      | 0.003      |
| 1020-030      | R1                       | 3                     | 40,000                             | 600                | 0.01       | 0.005      |



- Note:
- Use a machine with high accuracy for stable cutting.
  - Non-water soluble coolant recommended. Supply as a mist or external coolant. Take fire prevention precautions to avoid fire hazards caused by sparks igniting during machining or tool breakage.
  - Shorten overhang as much as possible.
  - Adjust cutting conditions as necessary as machine spec and other conditions may vary.
  - These cutting parameters show reference value. Adjust the cutting conditions to the desired machined surface finish.

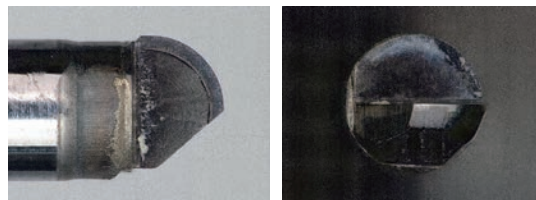
## UPDLB Milling Example for Finishing UDCBF / UPDLB R0.5 Cemented Carbide VF-20 (92.5HRA)



Milling Area : 10.2 × 10.2 × Depth 1.4 mm

Work Size : 20 × 20 × 10 mm

After Finishing



| Milling Process | Tool                             | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm)             | $a_e$ (mm) | Allowance (mm) | Coolant  | Cycle Time |
|-----------------|----------------------------------|------------------------------------|--------------------|------------------------|------------|----------------|----------|------------|
| Roughing        | UDCBF 2010-0070<br>(R0.5 x L0.7) | 30,000                             | 300                | 0.05                   | 0.25       | 0.005          | Air Blow | 30 min     |
| Semi-finishing  |                                  | 30,000                             | 300                | 0.001<br>(Cusp Height) | 0.06321    | 0.005          |          | 12 min     |
| Finishing       | UPDLB 1010-020<br>(R0.5 x EL2)   | 40,000                             | 400                | 0.0035                 | 0.00495    | 0              | Oil Mist | 1 h 30 min |

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral  
V Cutter

Drill

Drill

Technical Data

Technical Data

89



Size  $\phi 0.25 \sim \phi 2$  UDC

# UDCLRSF



Patented in Japan, US, China, Korea, Germany, Switzerland, and Liechtenstein

Additional 6 models

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       | ★                | ●                                     |

\* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

- $\phi 3\text{mm}$  Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Total 58 models

Unit (mm)

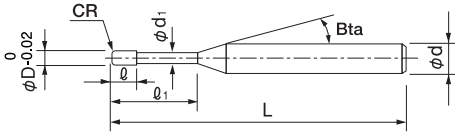
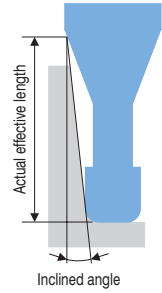
| Model Number          | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------------|---------------------------|------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| ※ UDCLRSF 20025-003X5 | 0.25                      | R0.03            | 0.5                    | 0.125             | 0.23                     | 16°                   | 50               | 4                       | 54,600                   |
| ※ UDCLRSF 20025-003X8 |                           |                  | 0.8                    |                   |                          |                       | 50               | 4                       | 54,600                   |
| ※ UDCLRSF 20025-005X5 |                           | R0.05            | 0.5                    |                   |                          |                       | 50               | 4                       | 54,600                   |
| ※ UDCLRSF 20025-005X8 | 0.8                       |                  | 50                     | 4                 | 54,600                   |                       |                  |                         |                          |
| UDCLRSF 2003-003006   | 0.3                       | R0.03            | 0.6                    | 0.15              | 0.28                     | 16°                   | 50               | 4                       | 54,600                   |
| ※ UDCLRSF 2003-003009 |                           |                  | 0.9                    |                   |                          |                       | 50               | 4                       | 54,600                   |
| UDCLRSF 2003-005006   |                           | R0.05            | 0.6                    |                   |                          |                       | 50               | 4                       | 54,600                   |
| ※ UDCLRSF 2003-005009 | 0.9                       |                  | 50                     | 4                 | 54,600                   |                       |                  |                         |                          |
| UDCLRSF 2005-003005   | 0.5                       | R0.03            | 0.5                    | 0.25              | 0.46                     | 16°                   | 50               | 4                       | 52,000                   |
| UDCLRSF 2005-003010   |                           |                  | 1                      |                   |                          |                       | 50               | 4                       | 52,000                   |
| UDCLRSF 2005-003015   |                           |                  | 1.5                    |                   |                          |                       | 50               | 4                       | 52,000                   |
| UDCLRSF 2005-005005   |                           | R0.05            | 0.5                    |                   |                          |                       | 50               | 4                       | 52,000                   |
| UDCLRSF 2005-005010   |                           |                  | 1                      |                   |                          |                       | 50               | 4                       | 52,000                   |
| UDCLRSF 2005-005015   | 1.5                       | 50               | 4                      | 52,000            |                          |                       |                  |                         |                          |
| UDCLRSF 2008-003008   | 0.8                       | R0.03            | 0.8                    | 0.4               | 0.76                     | 16°                   | 50               | 4                       | 46,700                   |
| UDCLRSF 2008-003016   |                           |                  | 1.6                    |                   |                          |                       | 50               | 4                       | 46,700                   |
| UDCLRSF 2008-003024   |                           |                  | 2.4                    |                   |                          |                       | 50               | 4                       | 46,700                   |
| UDCLRSF 2008-005008   |                           | R0.05            | 0.8                    |                   |                          |                       | 50               | 4                       | 46,700                   |
| UDCLRSF 2008-005016   |                           |                  | 1.6                    |                   |                          |                       | 50               | 4                       | 46,700                   |
| UDCLRSF 2008-005024   |                           |                  | 2.4                    |                   |                          |                       | 50               | 4                       | 46,700                   |
| UDCLRSF 2008-010008   |                           | R0.1             | 0.8                    |                   |                          |                       | 50               | 4                       | 46,700                   |
| UDCLRSF 2008-010016   |                           |                  | 1.6                    |                   |                          |                       | 50               | 4                       | 46,700                   |
| UDCLRSF 2008-010024   |                           |                  | 2.4                    |                   |                          |                       | 50               | 4                       | 46,700                   |

※Additional model



**Features**

Long Neck Radius End Mills for milling Cemented Carbide & Hard Brittle (Non-Metallic) Materials.  
 Upgraded version of UDCLRS.  
 Improved Diamond coating and optimum cutting geometries will "deep cuts" the material with offering long tool life.  
 Special cutting edge treatment helps to avoid the edge chipping & level gap on the work piece.  
 Recommended to use on semi-roughing & finishing process.



Label Sample



#001  $\phi D1.990 R+0.001/-0.001$

Diameter and Corner R accuracy measurements are printed on the label to support High Precision milling.

The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Unit (mm)

| Model Number        | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Effective Length by Inclined Angles |      |        |      |      |
|---------------------|---------------------------|------------------|---------------------------|-------------------------------------|------|--------|------|------|
|                     |                           |                  |                           | 30'                                 | 1°   | 1° 30' | 2°   | 3°   |
| UDCLRSF 2025-003X5  | 0.25                      | RO.03            | 0.5                       | 0.51                                | 0.53 | 0.54   | 0.56 | 0.60 |
| UDCLRSF 2025-003X8  |                           |                  | 0.8                       | 0.82                                | 0.84 | 0.87   | 0.90 | 0.97 |
| UDCLRSF 2025-005X5  |                           | RO.05            | 0.5                       | 0.51                                | 0.52 | 0.54   | 0.56 | 0.60 |
| UDCLRSF 2025-005X8  |                           |                  | 0.8                       | 0.82                                | 0.84 | 0.87   | 0.90 | 0.96 |
| UDCLRSF 2003-003006 | 0.3                       | RO.03            | 0.6                       | 0.61                                | 0.63 | 0.65   | 0.67 | 0.72 |
| UDCLRSF 2003-003009 |                           |                  | 0.9                       | 0.92                                | 0.95 | 0.98   | 1.02 | 1.09 |
| UDCLRSF 2003-005006 |                           | RO.05            | 0.6                       | 0.61                                | 0.63 | 0.65   | 0.67 | 0.72 |
| UDCLRSF 2003-005009 |                           |                  | 0.9                       | 0.92                                | 0.95 | 0.98   | 1.01 | 1.09 |
| UDCLRSF 2005-003005 | 0.5                       | RO.03            | 0.5                       | 0.55                                | 0.56 | 0.58   | 0.60 | 0.64 |
| UDCLRSF 2005-003010 |                           |                  | 1                         | 1.06                                | 1.10 | 1.13   | 1.17 | 1.25 |
| UDCLRSF 2005-003015 |                           |                  | 1.5                       | 1.58                                | 1.63 | 1.68   | 1.74 | 1.87 |
| UDCLRSF 2005-005005 |                           | RO.05            | 0.5                       | 0.55                                | 0.56 | 0.58   | 0.60 | 0.64 |
| UDCLRSF 2005-005010 |                           |                  | 1                         | 1.06                                | 1.09 | 1.13   | 1.17 | 1.25 |
| UDCLRSF 2005-005015 |                           |                  | 1.5                       | 1.58                                | 1.63 | 1.68   | 1.74 | 1.86 |
| UDCLRSF 2008-003008 | 0.8                       | RO.03            | 0.8                       | 0.86                                | 0.88 | 0.91   | 0.94 | 1.01 |
| UDCLRSF 2008-003016 |                           |                  | 1.6                       | 1.68                                | 1.73 | 1.79   | 1.85 | 1.99 |
| UDCLRSF 2008-003024 |                           |                  | 2.4                       | 2.51                                | 2.59 | 2.67   | 2.76 | 2.97 |
| UDCLRSF 2008-005008 |                           | RO.05            | 0.8                       | 0.85                                | 0.88 | 0.91   | 0.94 | 1.01 |
| UDCLRSF 2008-005016 |                           |                  | 1.6                       | 1.68                                | 1.73 | 1.79   | 1.85 | 1.98 |
| UDCLRSF 2008-005024 |                           |                  | 2.4                       | 2.50                                | 2.58 | 2.67   | 2.76 | 2.96 |
| UDCLRSF 2008-010008 |                           |                  | RO.1                      | 0.8                                 | 0.85 | 0.88   | 0.90 | 0.93 |
| UDCLRSF 2008-010016 |                           | 1.6              |                           | 1.68                                | 1.73 | 1.78   | 1.84 | 1.97 |
| UDCLRSF 2008-010024 |                           | 2.4              |                           | 2.50                                | 2.58 | 2.66   | 2.75 | 2.95 |

Next Page →

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Unit (mm)

| Model Number        | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |     |    |   |        |
|---------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-----|----|---|--------|
| UDCLRSF 2010-003010 | 1                         | RO.03            | 1                         | 0.5                  | 0.96                     | 16°                   | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2010-003020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2010-003040 |                           |                  | 4                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2010-003060 |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2010-005010 |                           | RO.05            | 1                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2010-005020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2010-005040 |                           |                  | 4                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2010-005060 |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2010-010010 |                           | RO.1             | 1                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2010-010020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2010-010040 |                           |                  | 4                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2010-010060 |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2015-003015 | 1.5                       | RO.03            | 1.5                       | 0.75                 | 1.44                     | 16°                   | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2015-003030 |                           |                  | 3                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2015-005015 |                           | RO.05            | 1.5                       |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2015-005030 |                           |                  | 3                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2015-010015 |                           | RO.1             | 1.5                       |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2015-010030 |                           |                  | 3                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2015-010040 |                           |                  | 4                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2015-010060 |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 46,700                   |     |    |   |        |
| UDCLRSF 2020-003020 |                           | 2                | RO.03                     |                      |                          |                       | 2                | 1                       | 1.9                      | 16° | 50 | 4 | 46,700 |
| UDCLRSF 2020-003040 |                           |                  |                           |                      |                          |                       | 4                |                         |                          |     | 50 | 4 | 46,700 |
| UDCLRSF 2020-003060 | 6                         |                  |                           | 50                   | 4                        | 46,700                |                  |                         |                          |     |    |   |        |
| UDCLRSF 2020-003080 | 8                         |                  |                           | 50                   | 4                        | 46,700                |                  |                         |                          |     |    |   |        |
| UDCLRSF 2020-003100 | 10                        |                  |                           | 50                   | 4                        | 46,700                |                  |                         |                          |     |    |   |        |
| UDCLRSF 2020-005020 | RO.05                     |                  |                           | 2                    | 50                       | 4                     | 46,700           |                         |                          |     |    |   |        |
| UDCLRSF 2020-005040 |                           |                  | 4                         | 50                   | 4                        | 46,700                |                  |                         |                          |     |    |   |        |
| UDCLRSF 2020-005060 |                           |                  | 6                         | 50                   | 4                        | 46,700                |                  |                         |                          |     |    |   |        |
| UDCLRSF 2020-005080 |                           |                  | 8                         | 50                   | 4                        | 46,700                |                  |                         |                          |     |    |   |        |
| UDCLRSF 2020-005100 |                           |                  | 10                        | 50                   | 4                        | 46,700                |                  |                         |                          |     |    |   |        |
| UDCLRSF 2020-010020 |                           |                  | RO.1                      | 2                    | 50                       | 4                     | 46,700           |                         |                          |     |    |   |        |
| UDCLRSF 2020-010040 | 4                         |                  |                           | 50                   | 4                        | 46,700                |                  |                         |                          |     |    |   |        |
| UDCLRSF 2020-010060 | 6                         |                  |                           | 50                   | 4                        | 46,700                |                  |                         |                          |     |    |   |        |
| UDCLRSF 2020-010080 | 8                         |                  |                           | 50                   | 4                        | 46,700                |                  |                         |                          |     |    |   |        |
| UDCLRSF 2020-010100 | 10                        |                  |                           | 50                   | 4                        | 46,700                |                  |                         |                          |     |    |   |        |

$\phi 3$ mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius  
Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



Unit (mm)

| Model Number        | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Effective Length by Inclined Angles |       |        |       |       |      |
|---------------------|---------------------------|------------------|---------------------------|-------------------------------------|-------|--------|-------|-------|------|
|                     |                           |                  |                           | 30'                                 | 1°    | 1° 30' | 2°    | 3°    |      |
| UDCLRSF 2010-003010 | 1                         | RO.03            | 1                         | 1.06                                | 1.10  | 1.13   | 1.17  | 1.25  |      |
| UDCLRSF 2010-003020 |                           |                  | 2                         | 2.09                                | 2.16  | 2.23   | 2.31  | 2.48  |      |
| UDCLRSF 2010-003040 |                           |                  | 4                         | 4.16                                | 4.29  | 4.43   | 4.59  | 4.93  |      |
| UDCLRSF 2010-003060 |                           |                  | 6                         | 6.22                                | 6.42  | 6.63   | 6.86  | 7.37  |      |
| UDCLRSF 2010-005010 |                           | RO.05            | 1                         | 1.06                                | 1.09  | 1.13   | 1.17  | 1.25  |      |
| UDCLRSF 2010-005020 |                           |                  | 2                         | 2.09                                | 2.16  | 2.23   | 2.31  | 2.47  |      |
| UDCLRSF 2010-005040 |                           |                  | 4                         | 4.15                                | 4.29  | 4.43   | 4.58  | 4.92  |      |
| UDCLRSF 2010-005060 |                           |                  | 6                         | 6.22                                | 6.42  | 6.63   | 6.86  | 7.37  |      |
| UDCLRSF 2010-010010 |                           | RO.1             | 1                         | 1.06                                | 1.09  | 1.12   | 1.16  | 1.24  |      |
| UDCLRSF 2010-010020 |                           |                  | 2                         | 2.09                                | 2.16  | 2.22   | 2.30  | 2.46  |      |
| UDCLRSF 2010-010040 |                           |                  | 4                         | 4.15                                | 4.28  | 4.43   | 4.58  | 4.91  |      |
| UDCLRSF 2010-010060 |                           |                  | 6                         | 6.22                                | 6.41  | 6.63   | 6.85  | 7.36  |      |
| UDCLRSF 2015-003015 | 1.5                       | RO.03            | 1.5                       | 1.61                                | 1.66  | 1.72   | 1.78  | 1.91  |      |
| UDCLRSF 2015-003030 |                           |                  | 3                         | 3.16                                | 3.26  | 3.37   | 3.49  | 3.74  |      |
| UDCLRSF 2015-005015 |                           | RO.05            | 1.5                       | 1.61                                | 1.66  | 1.72   | 1.78  | 1.90  |      |
| UDCLRSF 2015-005030 |                           |                  | 3                         | 3.16                                | 3.26  | 3.37   | 3.48  | 3.74  |      |
| UDCLRSF 2015-010015 |                           | RO.1             | 1.5                       | 1.61                                | 1.66  | 1.71   | 1.77  | 1.89  |      |
| UDCLRSF 2015-010030 |                           |                  | 3                         | 3.16                                | 3.26  | 3.36   | 3.48  | 3.73  |      |
| UDCLRSF 2015-010040 |                           |                  | 4                         | 4.19                                | 4.32  | 4.46   | 4.62  | 4.95  |      |
| UDCLRSF 2015-010060 |                           |                  | 6                         | 6.25                                | 6.45  | 6.66   | 6.89  | 7.40  |      |
| UDCLRSF 2020-003020 |                           | 2                | RO.03                     | 2                                   | 2.20  | 2.27   | 2.35  | 2.43  | 2.61 |
| UDCLRSF 2020-003040 |                           |                  |                           | 4                                   | 4.26  | 4.40   | 4.55  | 4.70  | 5.05 |
| UDCLRSF 2020-003060 | 6                         |                  |                           | 6.33                                | 6.53  | 6.75   | 6.98  | 7.50  |      |
| UDCLRSF 2020-003080 | 8                         |                  |                           | 8.39                                | 8.66  | 8.95   | 9.26  | 9.95  |      |
| UDCLRSF 2020-003100 | 10                        |                  |                           | 10.45                               | 10.79 | 11.15  | 11.54 | 12.40 |      |
| UDCLRSF 2020-005020 | RO.05                     |                  |                           | 2                                   | 2.20  | 2.27   | 2.34  | 2.42  | 2.60 |
| UDCLRSF 2020-005040 |                           |                  | 4                         | 4.26                                | 4.40  | 4.55   | 4.70  | 5.05  |      |
| UDCLRSF 2020-005060 |                           |                  | 6                         | 6.33                                | 6.53  | 6.75   | 6.98  | 7.50  |      |
| UDCLRSF 2020-005080 |                           |                  | 8                         | 8.39                                | 8.66  | 8.95   | 9.26  | 9.94  |      |
| UDCLRSF 2020-005100 |                           |                  | 10                        | 10.45                               | 10.79 | 11.15  | 11.53 | 12.39 |      |
| UDCLRSF 2020-010020 |                           |                  | RO.1                      | 2                                   | 2.20  | 2.27   | 2.34  | 2.42  | 2.59 |
| UDCLRSF 2020-010040 | 4                         |                  |                           | 4.26                                | 4.40  | 4.54   | 4.69  | 5.04  |      |
| UDCLRSF 2020-010060 | 6                         |                  |                           | 6.32                                | 6.53  | 6.74   | 6.97  | 7.49  |      |
| UDCLRSF 2020-010080 | 8                         |                  |                           | 8.39                                | 8.66  | 8.94   | 9.25  | 9.93  |      |
| UDCLRSF 2020-010100 | 10                        |                  |                           | 10.45                               | 10.79 | 11.14  | 11.53 | 12.38 |      |

$\phi 3\text{mm}$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for UDCLRSF

| WORK MATERIAL      | CEMENTED CARBIDE(≥87HRA) / HARD BRITTLE MATERIALS |                                    |                       |                     |                     |                    |                     |                     |                    |                     |                     |                    |                     |  |
|--------------------|---|------------------------------------|-----------------------|---------------------|---------------------|--------------------|---------------------|---------------------|--------------------|---------------------|---------------------|--------------------|---------------------|--|
|                    | Model Number                                      | Spindle Speed (min <sup>-1</sup> ) | Z-Level Milling       |                     |                     |                    | Flat Milling        |                     |                    | Side Milling        |                     |                    | Slotting            |  |
| Feed Rate (mm/min) |   |                                    | ※Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) |  |
| 20025-003X5        | 30,000  | 220                                | 50                    | 0.014               | 0.2                 | 220                | 0.014               | 0.2                 | 100                | 0.063               | 0.006               | 110                | 0.014               |  |
| 20025-003X8        | 30,000  | 170                                | 50                    | 0.014               | 0.2                 | 170                | 0.014               | 0.2                 | 80                 | 0.032               | 0.006               | 90                 | 0.014               |  |
| 20025-005X5        | 30,000  | 220                                | 50                    | 0.018               | 0.2                 | 220                | 0.018               | 0.2                 | 100                | 0.063               | 0.006               | 110                | 0.018               |  |
| 20025-005X8        | 30,000  | 170                                | 50                    | 0.018               | 0.2                 | 170                | 0.018               | 0.2                 | 80                 | 0.032               | 0.006               | 90                 | 0.018               |  |
| 2003-003006        | 30,000  | 220                                | 50                    | 0.015               | 0.2                 | 220                | 0.015               | 0.2                 | 110                | 0.075               | 0.006               | 110                | 0.015               |  |
| 2003-003009        | 30,000  | 175                                | 50                    | 0.015               | 0.2                 | 175                | 0.015               | 0.2                 | 90                 | 0.038               | 0.006               | 90                 | 0.015               |  |
| 2003-005006        | 30,000  | 220                                | 50                    | 0.02                | 0.2                 | 220                | 0.02                | 0.2                 | 110                | 0.075               | 0.006               | 110                | 0.02                |  |
| 2003-005009        | 30,000  | 175                                | 50                    | 0.02                | 0.2                 | 175                | 0.015               | 0.2                 | 90                 | 0.038               | 0.006               | 90                 | 0.02                |  |
| 2005-003005        | 30,000  | 190                                | 90                    | 0.02                | 0.4                 | 190                | 0.02                | 0.4                 | 180                | 0.25                | 0.01                | 190                | 0.02                |  |
| 2005-003010        | 30,000  | 190                                | 90                    | 0.02                | 0.4                 | 190                | 0.02                | 0.4                 | 180                | 0.125               | 0.01                | 190                | 0.02                |  |
| 2005-003015        | 30,000  | 140                                | 65                    | 0.015               | 0.3                 | 140                | 0.015               | 0.3                 | 130                | 0.125               | 0.007               | 140                | 0.015               |  |
| 2005-005005        | 30,000  | 190                                | 125                   | 0.02                | 0.4                 | 190                | 0.02                | 0.4                 | 180                | 0.25                | 0.01                | 190                | 0.02                |  |
| 2005-005010        | 30,000  | 190                                | 125                   | 0.02                | 0.4                 | 190                | 0.02                | 0.4                 | 180                | 0.125               | 0.01                | 190                | 0.02                |  |
| 2005-005015        | 30,000  | 140                                | 65                    | 0.015               | 0.3                 | 140                | 0.015               | 0.3                 | 130                | 0.125               | 0.007               | 140                | 0.015               |  |
| 2008-003008        | 30,000  | 190                                | 90                    | 0.02                | 0.6                 | 190                | 0.02                | 0.6                 | 300                | 0.4                 | 0.016               | 190                | 0.02                |  |
| 2008-003016        | 30,000  | 190                                | 90                    | 0.02                | 0.6                 | 190                | 0.02                | 0.6                 | 300                | 0.2                 | 0.01                | 190                | 0.02                |  |
| 2008-003024        | 30,000  | 175                                | 80                    | 0.018               | 0.5                 | 175                | 0.018               | 0.5                 | 275                | 0.2                 | 0.007               | 175                | 0.018               |  |
| 2008-005008        | 30,000  | 190                                | 150                   | 0.025               | 0.6                 | 190                | 0.025               | 0.6                 | 300                | 0.4                 | 0.016               | 190                | 0.025               |  |
| 2008-005016        | 30,000  | 190                                | 150                   | 0.025               | 0.6                 | 190                | 0.025               | 0.6                 | 300                | 0.2                 | 0.01                | 190                | 0.025               |  |
| 2008-005024        | 30,000  | 175                                | 80                    | 0.023               | 0.5                 | 175                | 0.023               | 0.5                 | 275                | 0.2                 | 0.007               | 175                | 0.023               |  |
| 2008-010008        | 30,000  | 190                                | 150                   | 0.03                | 0.6                 | 190                | 0.03                | 0.6                 | 300                | 0.4                 | 0.016               | 190                | 0.03                |  |
| 2008-010016        | 30,000  | 190                                | 150                   | 0.03                | 0.6                 | 190                | 0.03                | 0.6                 | 300                | 0.2                 | 0.01                | 190                | 0.03                |  |
| 2008-010024        | 30,000  | 175                                | 80                    | 0.028               | 0.5                 | 175                | 0.028               | 0.5                 | 275                | 0.2                 | 0.007               | 175                | 0.028               |  |
| 2010-003010        | 30,000  | 190                                | 90                    | 0.02                | 0.8                 | 190                | 0.02                | 0.8                 | 375                | 0.5                 | 0.02                | 190                | 0.02                |  |
| 2010-003020        | 30,000  | 190                                | 90                    | 0.02                | 0.8                 | 190                | 0.02                | 0.8                 | 375                | 0.25                | 0.01                | 190                | 0.02                |  |
| 2010-003040        | 30,000  | 190                                | 90                    | 0.016               | 0.6                 | 190                | 0.016               | 0.6                 | 375                | 0.25                | 0.005               | 190                | 0.016               |  |
| 2010-003060        | 25,000  | 155                                | 75                    | 0.01                | 0.5                 | 155                | 0.01                | 0.5                 | 300                | 0.25                | 0.005               | 155                | 0.01                |  |
| 2010-005010        | 30,000  | 190                                | 185                   | 0.025               | 0.8                 | 190                | 0.025               | 0.8                 | 375                | 0.5                 | 0.02                | 190                | 0.025               |  |
| 2010-005020        | 30,000  | 190                                | 185                   | 0.025               | 0.8                 | 190                | 0.025               | 0.8                 | 375                | 0.25                | 0.01                | 190                | 0.025               |  |
| 2010-005040        | 30,000  | 190                                | 185                   | 0.02                | 0.6                 | 190                | 0.02                | 0.6                 | 375                | 0.25                | 0.005               | 190                | 0.02                |  |
| 2010-005060        | 25,000  | 155                                | 150                   | 0.012               | 0.5                 | 155                | 0.012               | 0.5                 | 300                | 0.25                | 0.005               | 155                | 0.012               |  |
| 2010-010010        | 30,000  | 190                                | 185                   | 0.03                | 0.8                 | 190                | 0.03                | 0.8                 | 375                | 0.5                 | 0.02                | 190                | 0.03                |  |
| 2010-010020        | 30,000  | 190                                | 185                   | 0.03                | 0.8                 | 190                | 0.03                | 0.8                 | 375                | 0.25                | 0.01                | 190                | 0.03                |  |
| 2010-010040        | 30,000  | 190                                | 185                   | 0.025               | 0.6                 | 190                | 0.025               | 0.6                 | 375                | 0.25                | 0.005               | 190                | 0.025               |  |
| 2010-010060        | 25,000  | 155                                | 150                   | 0.015               | 0.5                 | 155                | 0.015               | 0.5                 | 300                | 0.25                | 0.005               | 155                | 0.015               |  |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

## Milling Conditions for UDCLRSF

| WORK MATERIAL |                                    | CEMENTED CARBIDE (<87HRA) |                       |                     |                     |                    |                     |                     |                    |                     |                     |                    |                     |
|---------------|------------------------------------|---------------------------|-----------------------|---------------------|---------------------|--------------------|---------------------|---------------------|--------------------|---------------------|---------------------|--------------------|---------------------|
| Model Number  | Spindle Speed (min <sup>-1</sup> ) | Z-Level Milling           |                       |                     |                     | Flat Milling       |                     |                     | Side Milling       |                     |                     | Slotting           |                     |
|               |                                    | Feed Rate (mm/min)        | ※Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) |
| 20025-003X5   | 24,000                             | 300                       | 50                    | 0.014               | 0.2                 | 300                | 0.014               | 0.2                 | 200                | 0.063               | 0.003               | 300                | 0.014               |
| 20025-003X8   | 24,000                             | 230                       | 50                    | 0.01                | 0.2                 | 230                | 0.01                | 0.2                 | 150                | 0.032               | 0.003               | 230                | 0.01                |
| 20025-005X5   | 24,000                             | 300                       | 50                    | 0.018               | 0.2                 | 300                | 0.018               | 0.2                 | 200                | 0.063               | 0.003               | 300                | 0.018               |
| 20025-005X8   | 24,000                             | 230                       | 50                    | 0.012               | 0.2                 | 230                | 0.012               | 0.2                 | 150                | 0.032               | 0.003               | 230                | 0.012               |
| 2003-003006   | 21,000                             | 300                       | 50                    | 0.015               | 0.2                 | 300                | 0.015               | 0.2                 | 200                | 0.075               | 0.003               | 300                | 0.015               |
| 2003-003009   | 21,000                             | 240                       | 50                    | 0.012               | 0.2                 | 240                | 0.012               | 0.2                 | 160                | 0.038               | 0.003               | 240                | 0.012               |
| 2003-005006   | 21,000                             | 300                       | 50                    | 0.02                | 0.2                 | 300                | 0.02                | 0.2                 | 200                | 0.075               | 0.003               | 300                | 0.02                |
| 2003-005009   | 21,000                             | 240                       | 50                    | 0.014               | 0.2                 | 240                | 0.014               | 0.2                 | 160                | 0.038               | 0.003               | 240                | 0.014               |
| 2005-003005   | 16,000                             | 500                       | 160                   | 0.02                | 0.4                 | 500                | 0.02                | 0.4                 | 800                | 0.25                | 0.005               | 500                | 0.02                |
| 2005-003010   | 16,000                             | 500                       | 160                   | 0.02                | 0.4                 | 500                | 0.02                | 0.4                 | 400                | 0.125               | 0.005               | 500                | 0.02                |
| 2005-003015   | 16,000                             | 375                       | 120                   | 0.014               | 0.3                 | 375                | 0.014               | 0.3                 | 300                | 0.125               | 0.005               | 375                | 0.014               |
| 2005-005005   | 16,000                             | 500                       | 160                   | 0.025               | 0.4                 | 500                | 0.025               | 0.4                 | 800                | 0.25                | 0.005               | 500                | 0.025               |
| 2005-005010   | 16,000                             | 500                       | 160                   | 0.025               | 0.4                 | 500                | 0.025               | 0.4                 | 400                | 0.125               | 0.005               | 500                | 0.025               |
| 2005-005015   | 16,000                             | 375                       | 120                   | 0.017               | 0.3                 | 375                | 0.017               | 0.3                 | 300                | 0.125               | 0.005               | 375                | 0.017               |
| 2008-003008   | 13,000                             | 390                       | 130                   | 0.02                | 0.6                 | 390                | 0.02                | 0.6                 | 1,200              | 0.4                 | 0.008               | 390                | 0.02                |
| 2008-003016   | 13,000                             | 390                       | 130                   | 0.02                | 0.6                 | 390                | 0.02                | 0.6                 | 600                | 0.2                 | 0.008               | 390                | 0.02                |
| 2008-003024   | 13,000                             | 350                       | 120                   | 0.014               | 0.5                 | 350                | 0.014               | 0.5                 | 540                | 0.2                 | 0.006               | 350                | 0.014               |
| 2008-005008   | 13,000                             | 390                       | 130                   | 0.025               | 0.6                 | 390                | 0.025               | 0.6                 | 1,200              | 0.4                 | 0.008               | 390                | 0.025               |
| 2008-005016   | 13,000                             | 390                       | 130                   | 0.025               | 0.6                 | 390                | 0.025               | 0.6                 | 600                | 0.2                 | 0.008               | 390                | 0.025               |
| 2008-005024   | 13,000                             | 350                       | 120                   | 0.017               | 0.5                 | 350                | 0.017               | 0.5                 | 540                | 0.2                 | 0.006               | 350                | 0.017               |
| 2008-010008   | 13,000                             | 390                       | 130                   | 0.03                | 0.6                 | 390                | 0.03                | 0.6                 | 1,200              | 0.4                 | 0.008               | 390                | 0.03                |
| 2008-010016   | 13,000                             | 390                       | 130                   | 0.03                | 0.6                 | 390                | 0.03                | 0.6                 | 600                | 0.2                 | 0.008               | 390                | 0.03                |
| 2008-010024   | 13,000                             | 350                       | 120                   | 0.02                | 0.5                 | 350                | 0.02                | 0.5                 | 540                | 0.2                 | 0.006               | 350                | 0.02                |
| 2010-003010   | 12,000                             | 360                       | 120                   | 0.02                | 0.8                 | 360                | 0.02                | 0.8                 | 1,440              | 0.5                 | 0.01                | 360                | 0.02                |
| 2010-003020   | 12,000                             | 360                       | 120                   | 0.02                | 0.8                 | 360                | 0.02                | 0.8                 | 720                | 0.25                | 0.01                | 360                | 0.02                |
| 2010-003040   | 10,000                             | 300                       | 100                   | 0.012               | 0.7                 | 300                | 0.012               | 0.7                 | 600                | 0.25                | 0.008               | 300                | 0.012               |
| 2010-003060   | 10,000                             | 300                       | 100                   | 0.008               | 0.7                 | 300                | 0.008               | 0.7                 | 600                | 0.25                | 0.006               | 300                | 0.008               |
| 2010-005010   | 12,000                             | 360                       | 120                   | 0.025               | 0.8                 | 360                | 0.025               | 0.8                 | 1,440              | 0.5                 | 0.01                | 360                | 0.025               |
| 2010-005020   | 12,000                             | 360                       | 120                   | 0.025               | 0.8                 | 360                | 0.025               | 0.8                 | 720                | 0.25                | 0.01                | 360                | 0.025               |
| 2010-005040   | 10,000                             | 300                       | 100                   | 0.015               | 0.7                 | 300                | 0.015               | 0.7                 | 600                | 0.25                | 0.008               | 300                | 0.015               |
| 2010-005060   | 10,000                             | 300                       | 100                   | 0.01                | 0.7                 | 300                | 0.01                | 0.7                 | 600                | 0.25                | 0.006               | 300                | 0.01                |
| 2010-010010   | 12,000                             | 360                       | 120                   | 0.03                | 0.8                 | 360                | 0.03                | 0.8                 | 1,440              | 0.5                 | 0.01                | 360                | 0.03                |
| 2010-010020   | 12,000                             | 360                       | 120                   | 0.03                | 0.8                 | 360                | 0.03                | 0.8                 | 720                | 0.25                | 0.01                | 360                | 0.03                |
| 2010-010040   | 10,000                             | 300                       | 100                   | 0.02                | 0.7                 | 300                | 0.02                | 0.7                 | 600                | 0.25                | 0.008               | 300                | 0.02                |
| 2010-010060   | 10,000                             | 300                       | 100                   | 0.012               | 0.7                 | 300                | 0.012               | 0.7                 | 600                | 0.25                | 0.006               | 300                | 0.012               |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
Square

Radius

Long Neck  
Radius  
Taper Neck  
RadiusBall / Long  
Shank Ball  
Long Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for UDCLRSF

| WORK MATERIAL | CEMENTED CARBIDE(≥87HRA) / HARD BRITTLE MATERIALS |                       |                          |                        |                        |                       |                        |                        |                       |                        |                        |                       |                        |
|---------------|---|-----------------------|--------------------------|------------------------|------------------------|-----------------------|------------------------|------------------------|-----------------------|------------------------|------------------------|-----------------------|------------------------|
|               | Spindle Speed<br>(min <sup>-1</sup> )             | Z-Level Milling       |                          |                        |                        | Flat Milling          |                        |                        | Side Milling          |                        |                        | Slotting              |                        |
|               |   | Feed Rate<br>(mm/min) | ※Feed Rate 2<br>(mm/min) | a <sub>p</sub><br>(mm) | a <sub>e</sub><br>(mm) | Feed Rate<br>(mm/min) | a <sub>p</sub><br>(mm) | a <sub>e</sub><br>(mm) | Feed Rate<br>(mm/min) | a <sub>p</sub><br>(mm) | a <sub>e</sub><br>(mm) | Feed Rate<br>(mm/min) | a <sub>p</sub><br>(mm) |
| 2015-003015   | 25,000  | 190                   | 90                       | 0.03                   | 1.3                    | 190                   | 0.03                   | 1.3                    | 375                   | 0.75                   | 0.02                   | 190                   | 0.03                   |
| 2015-003030   | 25,000  | 190                   | 90                       | 0.03                   | 1.3                    | 190                   | 0.03                   | 1.3                    | 375                   | 0.375                  | 0.01                   | 190                   | 0.03                   |
| 2015-005015   | 25,000  | 190                   | 125                      | 0.04                   | 1.3                    | 190                   | 0.04                   | 1.3                    | 375                   | 0.75                   | 0.02                   | 190                   | 0.04                   |
| 2015-005030   | 25,000  | 190                   | 125                      | 0.04                   | 1.3                    | 190                   | 0.04                   | 1.3                    | 375                   | 0.375                  | 0.01                   | 190                   | 0.04                   |
| 2015-010015   | 25,000  | 190                   | 150                      | 0.045                  | 1.3                    | 190                   | 0.045                  | 1.3                    | 375                   | 0.75                   | 0.02                   | 190                   | 0.045                  |
| 2015-010030   | 25,000  | 190                   | 150                      | 0.045                  | 1.3                    | 190                   | 0.045                  | 1.3                    | 375                   | 0.375                  | 0.01                   | 190                   | 0.045                  |
| 2015-010040   | 25,000  | 190                   | 150                      | 0.043                  | 1.2                    | 190                   | 0.043                  | 1.2                    | 350                   | 0.375                  | 0.008                  | 190                   | 0.043                  |
| 2015-010060   | 25,000  | 190                   | 150                      | 0.04                   | 1                      | 190                   | 0.04                   | 1                      | 350                   | 0.375                  | 0.005                  | 190                   | 0.04                   |
| 2020-003020   | 20,000  | 190                   | 90                       | 0.04                   | 1.8                    | 190                   | 0.04                   | 1.8                    | 375                   | 1                      | 0.02                   | 190                   | 0.04                   |
| 2020-003040   | 20,000  | 190                   | 90                       | 0.04                   | 1.8                    | 190                   | 0.04                   | 1.8                    | 375                   | 0.5                    | 0.01                   | 190                   | 0.04                   |
| 2020-003060   | 20,000  | 190                   | 90                       | 0.037                  | 1.7                    | 190                   | 0.037                  | 1.7                    | 325                   | 0.5                    | 0.007                  | 190                   | 0.037                  |
| 2020-003080   | 20,000  | 190                   | 90                       | 0.03                   | 1.5                    | 190                   | 0.03                   | 1.5                    | 325                   | 0.5                    | 0.005                  | 190                   | 0.03                   |
| 2020-003100   | 20,000  | 190                   | 90                       | 0.025                  | 1.3                    | 190                   | 0.025                  | 1.3                    | 300                   | 0.5                    | 0.005                  | 190                   | 0.025                  |
| 2020-005020   | 20,000  | 190                   | 90                       | 0.05                   | 1.8                    | 190                   | 0.05                   | 1.8                    | 375                   | 1                      | 0.02                   | 190                   | 0.05                   |
| 2020-005040   | 20,000  | 190                   | 90                       | 0.05                   | 1.8                    | 190                   | 0.05                   | 1.8                    | 375                   | 0.5                    | 0.01                   | 190                   | 0.05                   |
| 2020-005060   | 20,000  | 190                   | 90                       | 0.045                  | 1.7                    | 190                   | 0.045                  | 1.7                    | 325                   | 0.5                    | 0.007                  | 190                   | 0.045                  |
| 2020-005080   | 20,000  | 190                   | 90                       | 0.04                   | 1.5                    | 190                   | 0.04                   | 1.5                    | 325                   | 0.5                    | 0.005                  | 190                   | 0.04                   |
| 2020-005100   | 20,000  | 190                   | 90                       | 0.028                  | 1.3                    | 190                   | 0.028                  | 1.3                    | 300                   | 0.5                    | 0.005                  | 190                   | 0.028                  |
| 2020-010020   | 20,000  | 190                   | 125                      | 0.06                   | 1.8                    | 190                   | 0.06                   | 1.8                    | 375                   | 1                      | 0.02                   | 190                   | 0.06                   |
| 2020-010040   | 20,000  | 190                   | 125                      | 0.06                   | 1.8                    | 190                   | 0.06                   | 1.8                    | 375                   | 0.5                    | 0.01                   | 190                   | 0.06                   |
| 2020-010060   | 20,000  | 190                   | 125                      | 0.055                  | 1.7                    | 190                   | 0.055                  | 1.7                    | 325                   | 0.5                    | 0.007                  | 190                   | 0.055                  |
| 2020-010080   | 20,000  | 190                   | 125                      | 0.045                  | 1.5                    | 190                   | 0.045                  | 1.5                    | 325                   | 0.5                    | 0.005                  | 190                   | 0.045                  |
| 2020-010100   | 20,000  | 190                   | 125                      | 0.033                  | 1.3                    | 190                   | 0.033                  | 1.3                    | 300                   | 0.5                    | 0.005                  | 190                   | 0.033                  |

These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (TAS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only. Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials. For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

※Feed Rate2: Feed rate of approach and \*connection moves.  
\*Changing from one engagement point to the next.

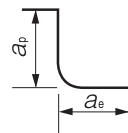
- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for UDCLRSF

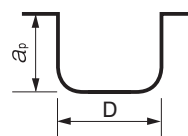
| WORK MATERIAL |                                    | CEMENTED CARBIDE (<87HRA) |                       |                     |                     |                    |                     |                     |                    |                     |                     |                    |                     |  |
|---------------|------------------------------------|---------------------------|-----------------------|---------------------|---------------------|--------------------|---------------------|---------------------|--------------------|---------------------|---------------------|--------------------|---------------------|--|
| Model Number  | Spindle Speed (min <sup>-1</sup> ) | Z-Level Milling           |                       |                     |                     | Flat Milling       |                     |                     | Side Milling       |                     |                     | Slotting           |                     |  |
|               |                                    | Feed Rate (mm/min)        | ※Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) |  |
| 2015-003015   | 11,000                             | 330                       | 110                   | 0.03                | 1.3                 | 330                | 0.03                | 1.3                 | 1,440              | 0.75                | 0.01                | 330                | 0.03                |  |
| 2015-003030   | 11,000                             | 330                       | 110                   | 0.03                | 1.3                 | 330                | 0.03                | 1.3                 | 720                | 0.375               | 0.01                | 330                | 0.03                |  |
| 2015-005015   | 11,000                             | 330                       | 110                   | 0.04                | 1.3                 | 330                | 0.04                | 1.3                 | 1,440              | 0.75                | 0.01                | 330                | 0.04                |  |
| 2015-005030   | 11,000                             | 330                       | 110                   | 0.04                | 1.3                 | 330                | 0.04                | 1.3                 | 720                | 0.375               | 0.01                | 330                | 0.04                |  |
| 2015-010015   | 11,000                             | 330                       | 110                   | 0.045               | 1.3                 | 330                | 0.045               | 1.3                 | 1,440              | 0.75                | 0.01                | 330                | 0.045               |  |
| 2015-010030   | 11,000                             | 330                       | 110                   | 0.045               | 1.3                 | 330                | 0.045               | 1.3                 | 720                | 0.375               | 0.01                | 330                | 0.045               |  |
| 2015-010040   | 11,000                             | 330                       | 110                   | 0.045               | 1.1                 | 330                | 0.045               | 1.1                 | 720                | 0.375               | 0.01                | 330                | 0.045               |  |
| 2015-010060   | 11,000                             | 330                       | 110                   | 0.03                | 1.1                 | 330                | 0.03                | 1.1                 | 720                | 0.375               | 0.009               | 330                | 0.03                |  |
| 2020-003020   | 10,000                             | 300                       | 100                   | 0.04                | 1.8                 | 300                | 0.04                | 1.8                 | 1,440              | 1                   | 0.01                | 300                | 0.04                |  |
| 2020-003040   | 10,000                             | 300                       | 100                   | 0.04                | 1.8                 | 300                | 0.04                | 1.8                 | 1,440              | 1                   | 0.01                | 300                | 0.04                |  |
| 2020-003060   | 10,000                             | 300                       | 100                   | 0.036               | 1.6                 | 300                | 0.036               | 1.6                 | 1,440              | 0.5                 | 0.01                | 300                | 0.036               |  |
| 2020-003080   | 10,000                             | 300                       | 100                   | 0.023               | 1.6                 | 300                | 0.023               | 1.6                 | 1,440              | 0.5                 | 0.009               | 300                | 0.023               |  |
| 2020-003100   | 10,000                             | 300                       | 100                   | 0.018               | 1.6                 | 300                | 0.018               | 1.6                 | 1,440              | 0.5                 | 0.009               | 300                | 0.018               |  |
| 2020-005020   | 10,000                             | 300                       | 100                   | 0.05                | 1.8                 | 300                | 0.05                | 1.8                 | 1,440              | 1                   | 0.01                | 300                | 0.05                |  |
| 2020-005040   | 10,000                             | 300                       | 100                   | 0.05                | 1.8                 | 300                | 0.05                | 1.8                 | 1,440              | 1                   | 0.01                | 300                | 0.05                |  |
| 2020-005060   | 10,000                             | 300                       | 100                   | 0.045               | 1.6                 | 300                | 0.045               | 1.6                 | 1,440              | 0.5                 | 0.01                | 300                | 0.045               |  |
| 2020-005080   | 10,000                             | 300                       | 100                   | 0.028               | 1.6                 | 300                | 0.028               | 1.6                 | 1,440              | 0.5                 | 0.009               | 300                | 0.028               |  |
| 2020-005100   | 10,000                             | 300                       | 100                   | 0.02                | 1.6                 | 300                | 0.02                | 1.6                 | 1,440              | 0.5                 | 0.009               | 300                | 0.02                |  |
| 2020-010020   | 10,000                             | 300                       | 100                   | 0.06                | 1.8                 | 300                | 0.06                | 1.8                 | 1,440              | 1                   | 0.01                | 300                | 0.06                |  |
| 2020-010040   | 10,000                             | 300                       | 100                   | 0.06                | 1.8                 | 300                | 0.06                | 1.8                 | 1,440              | 1                   | 0.01                | 300                | 0.06                |  |
| 2020-010060   | 10,000                             | 300                       | 100                   | 0.054               | 1.6                 | 300                | 0.054               | 1.6                 | 1,440              | 0.5                 | 0.01                | 300                | 0.054               |  |
| 2020-010080   | 10,000                             | 300                       | 100                   | 0.034               | 1.6                 | 300                | 0.034               | 1.6                 | 1,440              | 0.5                 | 0.009               | 300                | 0.034               |  |
| 2020-010100   | 10,000                             | 300                       | 100                   | 0.023               | 1.6                 | 300                | 0.023               | 1.6                 | 1,440              | 0.5                 | 0.009               | 300                | 0.023               |  |

## Note:

- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Does not require to be slowed down in the approach sequence when slotting and side milling.
- Use an inclined or helical approach when Z-level milling (Recommended inclination angle: <1 degree).
- For flat and side milling, set the axial depth (a<sub>p</sub>) and radial depth (a<sub>e</sub>) to allow for the uncut material of the corner radius.
- Decrease both spindle speed and feed rate proportionally.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.



Z-Level / Side / Flat Milling

Slotting  
D : Outside Diameter (mm)Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
Radius  
Taper Neck  
RadiusBall / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.3 \sim \phi 2$



# UDCLRS



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |   |         |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|---|---------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |   |         |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |   |         |
|                               |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  | ○<br>*1                               | ★ | ●<br>*2 |

\*1 UDCLRSF series are highly recommended for Glass Filled Plastic milling.

\*2 Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

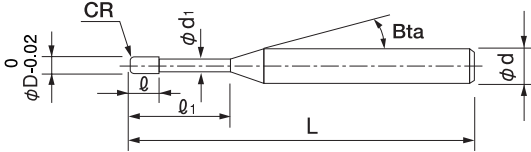
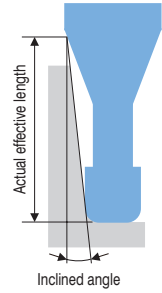
Total 30 models

Unit (mm)

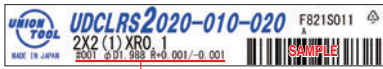
| Model Number        | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|---------------------|---------------------------|------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| UDCLRS 2003-003-006 | 0.3                       | RO.03            | 0.6                    | 0.15              | 0.28                     | 16°                   | 50               | 4                       | 45,500                   |
| UDCLRS 2003-005-006 |                           | RO.05            | 0.6                    |                   |                          |                       | 50               | 4                       | 45,500                   |
| UDCLRS 2005-003-005 | 0.5                       | RO.03            | 0.5                    | 0.25              | 0.46                     | 16°                   | 50               | 4                       | 43,300                   |
| UDCLRS 2005-003-010 |                           |                  | 1                      |                   |                          |                       | 50               | 4                       | 43,300                   |
| UDCLRS 2005-005-005 |                           | RO.05            | 0.5                    |                   |                          |                       | 50               | 4                       | 43,300                   |
| UDCLRS 2005-005-010 |                           |                  | 1                      |                   |                          |                       | 50               | 4                       | 43,300                   |
| UDCLRS 2008-003-008 | 0.8                       | RO.03            | 0.8                    | 0.4               | 0.76                     | 16°                   | 50               | 4                       | 38,900                   |
| UDCLRS 2008-003-016 |                           |                  | 1.6                    |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2008-005-008 |                           | RO.05            | 0.8                    |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2008-005-016 |                           |                  | 1.6                    |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2008-010-008 |                           | RO.1             | 0.8                    |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2008-010-016 |                           |                  | 1.6                    |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2010-003-010 | 1                         | RO.03            | 1                      | 0.5               | 0.96                     | 16°                   | 50               | 4                       | 38,900                   |
| UDCLRS 2010-003-020 |                           |                  | 2                      |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2010-005-010 |                           | RO.05            | 1                      |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2010-005-020 |                           |                  | 2                      |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2010-010-010 |                           | RO.1             | 1                      |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2010-010-020 |                           |                  | 2                      |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2015-003-015 | 1.5                       | RO.03            | 1.5                    | 0.75              | 1.44                     | 16°                   | 50               | 4                       | 38,900                   |
| UDCLRS 2015-003-030 |                           |                  | 3                      |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2015-005-015 |                           | RO.05            | 1.5                    |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2015-005-030 |                           |                  | 3                      |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2015-010-015 |                           | RO.1             | 1.5                    |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2015-010-030 |                           |                  | 3                      |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2020-003-020 | 2                         | RO.03            | 2                      | 1                 | 1.9                      | 16°                   | 50               | 4                       | 38,900                   |
| UDCLRS 2020-003-040 |                           |                  | 4                      |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2020-005-020 |                           | RO.05            | 2                      |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2020-005-040 |                           |                  | 4                      |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2020-010-020 |                           | RO.1             | 2                      |                   |                          |                       | 50               | 4                       | 38,900                   |
| UDCLRS 2020-010-040 |                           |                  | 4                      |                   |                          |                       | 50               | 4                       | 38,900                   |

**Features**

UDC offers excellent drilling performance on Cemented Carbide and Hard Brittle (Non-Metallic) Materials. Developed to give improved hardness and durability, the new Diamond coating also has outstanding adhesion to the cutting tool. By combining the new coating with optimum cutting geometries, the tool "deep cuts" the work piece. Leaves a burr and pit free surface finish whether roughing, semi-finishing or finishing.



Label Sample



#001 φD1.988 R+0.001/-0.001

Diameter and Corner R accuracy measurements are printed on the label to support High Precision milling.

The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Unit (mm)

| Model Number        | Outside Diameter φD | Corner Radius CR | Effective Length ℓ <sub>1</sub> | Effective Length by Inclined Angles |      |        |      |      |
|---------------------|---------------------|------------------|---------------------------------|-------------------------------------|------|--------|------|------|
|                     |                     |                  |                                 | 30'                                 | 1°   | 1° 30' | 2°   | 3°   |
| UDCLRS 2003-003-006 | 0.3                 | RO.03            | 0.6                             | 0.61                                | 0.63 | 0.65   | 0.67 | 0.72 |
| UDCLRS 2003-005-006 |                     | RO.05            | 0.6                             | 0.61                                | 0.63 | 0.65   | 0.67 | 0.72 |
| UDCLRS 2005-003-005 | 0.5                 | RO.03            | 0.5                             | 0.55                                | 0.56 | 0.58   | 0.60 | 0.64 |
| UDCLRS 2005-003-010 |                     |                  | 1                               | 1.06                                | 1.10 | 1.13   | 1.17 | 1.25 |
| UDCLRS 2005-005-005 |                     | RO.05            | 0.5                             | 0.55                                | 0.56 | 0.58   | 0.60 | 0.64 |
| UDCLRS 2005-005-010 |                     |                  | 1                               | 1.06                                | 1.09 | 1.13   | 1.17 | 1.25 |
| UDCLRS 2008-003-008 | 0.8                 | RO.03            | 0.8                             | 0.86                                | 0.88 | 0.91   | 0.94 | 1.01 |
| UDCLRS 2008-003-016 |                     |                  | 1.6                             | 1.68                                | 1.73 | 1.79   | 1.85 | 1.99 |
| UDCLRS 2008-005-008 |                     | RO.05            | 0.8                             | 0.85                                | 0.88 | 0.91   | 0.94 | 1.01 |
| UDCLRS 2008-005-016 |                     |                  | 1.6                             | 1.68                                | 1.73 | 1.79   | 1.85 | 1.98 |
| UDCLRS 2008-010-008 |                     | RO.1             | 0.8                             | 0.85                                | 0.88 | 0.90   | 0.93 | 0.99 |
| UDCLRS 2008-010-016 |                     |                  | 1.6                             | 1.68                                | 1.73 | 1.78   | 1.84 | 1.97 |
| UDCLRS 2010-003-010 | 1                   | RO.03            | 1                               | 1.06                                | 1.10 | 1.13   | 1.17 | 1.25 |
| UDCLRS 2010-003-020 |                     |                  | 2                               | 2.09                                | 2.16 | 2.23   | 2.31 | 2.48 |
| UDCLRS 2010-005-010 |                     | RO.05            | 1                               | 1.06                                | 1.09 | 1.13   | 1.17 | 1.25 |
| UDCLRS 2010-005-020 |                     |                  | 2                               | 2.09                                | 2.16 | 2.23   | 2.31 | 2.47 |
| UDCLRS 2010-010-010 |                     | RO.1             | 1                               | 1.06                                | 1.09 | 1.12   | 1.16 | 1.24 |
| UDCLRS 2010-010-020 |                     |                  | 2                               | 2.09                                | 2.16 | 2.22   | 2.30 | 2.46 |
| UDCLRS 2015-003-015 | 1.5                 | RO.03            | 1.5                             | 1.61                                | 1.66 | 1.72   | 1.78 | 1.91 |
| UDCLRS 2015-003-030 |                     |                  | 3                               | 3.16                                | 3.26 | 3.37   | 3.49 | 3.74 |
| UDCLRS 2015-005-015 |                     | RO.05            | 1.5                             | 1.61                                | 1.66 | 1.72   | 1.78 | 1.90 |
| UDCLRS 2015-005-030 |                     |                  | 3                               | 3.16                                | 3.26 | 3.37   | 3.48 | 3.74 |
| UDCLRS 2015-010-015 |                     | RO.1             | 1.5                             | 1.61                                | 1.66 | 1.71   | 1.77 | 1.89 |
| UDCLRS 2015-010-030 |                     |                  | 3                               | 3.16                                | 3.26 | 3.36   | 3.48 | 3.73 |
| UDCLRS 2020-003-020 | 2                   | RO.03            | 2                               | 2.20                                | 2.27 | 2.35   | 2.43 | 2.61 |
| UDCLRS 2020-003-040 |                     |                  | 4                               | 4.26                                | 4.40 | 4.55   | 4.70 | 5.05 |
| UDCLRS 2020-005-020 |                     | RO.05            | 2                               | 2.20                                | 2.27 | 2.34   | 2.42 | 2.60 |
| UDCLRS 2020-005-040 |                     |                  | 4                               | 4.26                                | 4.40 | 4.55   | 4.70 | 5.05 |
| UDCLRS 2020-010-020 |                     | RO.1             | 2                               | 2.20                                | 2.27 | 2.34   | 2.42 | 2.59 |
| UDCLRS 2020-010-040 |                     |                  | 4                               | 4.26                                | 4.40 | 4.54   | 4.69 | 5.04 |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

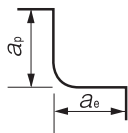
Drill

Technical Data

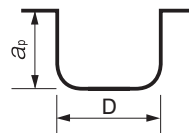


## Milling Conditions for UDCLRS

| WORK MATERIAL | CEMENTED CARBIDE(≥87HRA) / HARD BRITTLE MATERIALS |                    |                       |                     |                     |                    |                     |                     |                    |                     |                     |                    |                     |  |
|---------------|---|--------------------|-----------------------|---------------------|---------------------|--------------------|---------------------|---------------------|--------------------|---------------------|---------------------|--------------------|---------------------|--|
|               | Spindle Speed (min <sup>-1</sup> )                | Z-Level Milling    |                       |                     |                     | Flat Milling       |                     |                     | Side Milling       |                     |                     | Slotting           |                     |  |
|               |   | Feed Rate (mm/min) | ※Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) |  |
| 2003-003-006  | 30,000  | 220                | 50                    | 0.01                | 0.2                 | 220                | 0.01                | 0.2                 | 110                | 0.05                | 0.001               | 110                | 0.01                |  |
| 2003-005-006  | 30,000  | 220                | 50                    | 0.01                | 0.2                 | 220                | 0.01                | 0.2                 | 110                | 0.05                | 0.001               | 110                | 0.01                |  |
| 2005-003-005  | 30,000  | 185                | 90                    | 0.01                | 0.4                 | 185                | 0.01                | 0.4                 | 375                | 0.25                | 0.005               | 375                | 0.01                |  |
| 2005-003-010  | 30,000  | 185                | 90                    | 0.01                | 0.4                 | 185                | 0.01                | 0.4                 | 180                | 0.125               | 0.005               | 375                | 0.01                |  |
| 2005-005-005  | 30,000  | 375                | 125                   | 0.01                | 0.4                 | 375                | 0.01                | 0.4                 | 375                | 0.25                | 0.005               | 375                | 0.01                |  |
| 2005-005-010  | 30,000  | 375                | 125                   | 0.01                | 0.4                 | 375                | 0.01                | 0.4                 | 180                | 0.125               | 0.005               | 375                | 0.01                |  |
| 2008-003-008  | 30,000  | 185                | 90                    | 0.01                | 0.6                 | 185                | 0.01                | 0.6                 | 600                | 0.4                 | 0.008               | 375                | 0.01                |  |
| 2008-003-016  | 30,000  | 185                | 90                    | 0.01                | 0.6                 | 185                | 0.01                | 0.6                 | 300                | 0.2                 | 0.008               | 375                | 0.01                |  |
| 2008-005-008  | 30,000  | 375                | 150                   | 0.01                | 0.6                 | 375                | 0.01                | 0.6                 | 600                | 0.4                 | 0.008               | 375                | 0.01                |  |
| 2008-005-016  | 30,000  | 375                | 150                   | 0.01                | 0.6                 | 375                | 0.01                | 0.6                 | 300                | 0.2                 | 0.008               | 375                | 0.01                |  |
| 2008-010-008  | 30,000  | 375                | 150                   | 0.01                | 0.6                 | 375                | 0.01                | 0.6                 | 600                | 0.4                 | 0.008               | 375                | 0.01                |  |
| 2008-010-016  | 30,000  | 375                | 150                   | 0.01                | 0.6                 | 375                | 0.01                | 0.6                 | 300                | 0.2                 | 0.008               | 375                | 0.01                |  |
| 2010-003-010  | 30,000  | 185                | 90                    | 0.01                | 0.8                 | 185                | 0.01                | 0.8                 | 750                | 0.5                 | 0.01                | 375                | 0.01                |  |
| 2010-003-020  | 30,000  | 185                | 90                    | 0.01                | 0.8                 | 185                | 0.01                | 0.8                 | 375                | 0.25                | 0.01                | 375                | 0.01                |  |
| 2010-005-010  | 30,000  | 375                | 185                   | 0.01                | 0.8                 | 375                | 0.01                | 0.8                 | 750                | 0.5                 | 0.01                | 375                | 0.01                |  |
| 2010-005-020  | 30,000  | 375                | 185                   | 0.01                | 0.8                 | 375                | 0.01                | 0.8                 | 375                | 0.25                | 0.01                | 375                | 0.01                |  |
| 2010-010-010  | 30,000  | 375                | 185                   | 0.01                | 0.8                 | 375                | 0.01                | 0.8                 | 750                | 0.5                 | 0.01                | 375                | 0.01                |  |
| 2010-010-020  | 30,000  | 375                | 185                   | 0.01                | 0.8                 | 375                | 0.01                | 0.8                 | 375                | 0.25                | 0.01                | 375                | 0.01                |  |
| 2015-003-015  | 25,000  | 185                | 90                    | 0.01                | 1.3                 | 185                | 0.01                | 1.3                 | 750                | 0.75                | 0.01                | 375                | 0.015               |  |
| 2015-003-030  | 25,000  | 185                | 90                    | 0.01                | 1.3                 | 185                | 0.01                | 1.3                 | 375                | 0.375               | 0.01                | 375                | 0.015               |  |
| 2015-005-015  | 25,000  | 375                | 125                   | 0.015               | 1.3                 | 375                | 0.015               | 1.3                 | 750                | 0.75                | 0.01                | 375                | 0.015               |  |
| 2015-005-030  | 25,000  | 375                | 125                   | 0.015               | 1.3                 | 375                | 0.015               | 1.3                 | 375                | 0.375               | 0.01                | 375                | 0.015               |  |
| 2015-010-015  | 25,000  | 375                | 150                   | 0.015               | 1.3                 | 375                | 0.015               | 1.3                 | 750                | 0.75                | 0.01                | 375                | 0.015               |  |
| 2015-010-030  | 25,000  | 375                | 150                   | 0.015               | 1.3                 | 375                | 0.015               | 1.3                 | 375                | 0.375               | 0.01                | 375                | 0.015               |  |
| 2020-003-020  | 20,000  | 185                | 90                    | 0.01                | 1.8                 | 185                | 0.01                | 1.8                 | 750                | 1                   | 0.01                | 375                | 0.02                |  |
| 2020-003-040  | 20,000  | 185                | 90                    | 0.01                | 1.8                 | 185                | 0.01                | 1.8                 | 375                | 0.5                 | 0.01                | 375                | 0.02                |  |
| 2020-005-020  | 20,000  | 375                | 90                    | 0.02                | 1.8                 | 375                | 0.02                | 1.8                 | 750                | 1                   | 0.01                | 375                | 0.02                |  |
| 2020-005-040  | 20,000  | 375                | 90                    | 0.02                | 1.8                 | 375                | 0.02                | 1.8                 | 375                | 0.5                 | 0.01                | 375                | 0.02                |  |
| 2020-010-020  | 20,000  | 375                | 125                   | 0.02                | 1.8                 | 375                | 0.02                | 1.8                 | 750                | 1                   | 0.01                | 375                | 0.02                |  |
| 2020-010-040  | 20,000  | 375                | 125                   | 0.02                | 1.8                 | 375                | 0.02                | 1.8                 | 375                | 0.5                 | 0.01                | 375                | 0.02                |  |



Z-Level / Side / Flat Milling



Slotting  
D : Outside Diameter (mm)



## Milling Conditions for UDCLRS

| WORK MATERIAL | CEMENTED CARBIDE (<87HRA)          |                    |                       |                     |                     |                    |                     |                     |                    |                     |                     |                    |                     |
|---------------|------------------------------------|--------------------|-----------------------|---------------------|---------------------|--------------------|---------------------|---------------------|--------------------|---------------------|---------------------|--------------------|---------------------|
|               | Spindle Speed (min <sup>-1</sup> ) | Z-Level Milling    |                       |                     |                     | Flat Milling       |                     |                     | Side Milling       |                     |                     | Slotting           |                     |
|               |                                    | Feed Rate (mm/min) | ※Feed Rate 2 (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Feed Rate (mm/min) | a <sub>p</sub> (mm) |
| 2003-003-006  | 21,000                             | 220                | 50                    | 0.01                | 0.2                 | 220                | 0.01                | 0.2                 | 200                | 0.075               | 0.003               | 200                | 0.01                |
| 2003-005-006  | 21,000                             | 220                | 50                    | 0.01                | 0.2                 | 220                | 0.01                | 0.2                 | 200                | 0.075               | 0.003               | 200                | 0.01                |
| 2005-003-005  | 20,000                             | 275                | 135                   | 0.02                | 0.4                 | 275                | 0.02                | 0.4                 | 800                | 0.25                | 0.005               | 550                | 0.02                |
| 2005-003-010  | 20,000                             | 275                | 135                   | 0.02                | 0.4                 | 275                | 0.02                | 0.4                 | 400                | 0.125               | 0.005               | 550                | 0.02                |
| 2005-005-005  | 20,000                             | 550                | 180                   | 0.02                | 0.4                 | 550                | 0.02                | 0.4                 | 800                | 0.25                | 0.005               | 550                | 0.02                |
| 2005-005-010  | 20,000                             | 550                | 180                   | 0.02                | 0.4                 | 550                | 0.02                | 0.4                 | 400                | 0.125               | 0.005               | 550                | 0.02                |
| 2008-003-008  | 19,000                             | 290                | 145                   | 0.02                | 0.6                 | 290                | 0.02                | 0.6                 | 1,200              | 0.4                 | 0.008               | 580                | 0.025               |
| 2008-003-016  | 19,000                             | 290                | 145                   | 0.02                | 0.6                 | 290                | 0.02                | 0.6                 | 600                | 0.2                 | 0.008               | 580                | 0.025               |
| 2008-005-008  | 19,000                             | 580                | 190                   | 0.025               | 0.6                 | 580                | 0.025               | 0.6                 | 1,200              | 0.4                 | 0.008               | 580                | 0.025               |
| 2008-005-016  | 19,000                             | 580                | 190                   | 0.025               | 0.6                 | 580                | 0.025               | 0.6                 | 600                | 0.2                 | 0.008               | 580                | 0.025               |
| 2008-010-008  | 19,000                             | 580                | 190                   | 0.025               | 0.6                 | 580                | 0.025               | 0.6                 | 1,200              | 0.4                 | 0.008               | 580                | 0.025               |
| 2008-010-016  | 19,000                             | 580                | 190                   | 0.025               | 0.6                 | 580                | 0.025               | 0.6                 | 600                | 0.2                 | 0.008               | 580                | 0.025               |
| 2010-003-010  | 18,250                             | 300                | 150                   | 0.02                | 0.8                 | 300                | 0.02                | 0.8                 | 1,440              | 0.5                 | 0.01                | 600                | 0.025               |
| 2010-003-020  | 18,250                             | 300                | 150                   | 0.02                | 0.8                 | 300                | 0.02                | 0.8                 | 720                | 0.25                | 0.01                | 600                | 0.025               |
| 2010-005-010  | 18,250                             | 600                | 200                   | 0.025               | 0.8                 | 600                | 0.025               | 0.8                 | 1,440              | 0.5                 | 0.01                | 600                | 0.025               |
| 2010-005-020  | 18,250                             | 600                | 200                   | 0.025               | 0.8                 | 600                | 0.025               | 0.8                 | 720                | 0.25                | 0.01                | 600                | 0.025               |
| 2010-010-010  | 18,250                             | 600                | 200                   | 0.025               | 0.8                 | 600                | 0.025               | 0.8                 | 1,440              | 0.5                 | 0.01                | 600                | 0.025               |
| 2010-010-020  | 18,250                             | 600                | 200                   | 0.025               | 0.8                 | 600                | 0.025               | 0.8                 | 720                | 0.25                | 0.01                | 600                | 0.025               |
| 2015-003-015  | 16,500                             | 325                | 160                   | 0.02                | 1.3                 | 325                | 0.02                | 1.3                 | 1,440              | 0.75                | 0.01                | 650                | 0.035               |
| 2015-003-030  | 16,500                             | 325                | 160                   | 0.02                | 1.3                 | 325                | 0.02                | 1.3                 | 720                | 0.375               | 0.01                | 650                | 0.035               |
| 2015-005-015  | 16,500                             | 650                | 210                   | 0.035               | 1.3                 | 650                | 0.035               | 1.3                 | 1,440              | 0.75                | 0.01                | 650                | 0.035               |
| 2015-005-030  | 16,500                             | 650                | 210                   | 0.035               | 1.3                 | 650                | 0.035               | 1.3                 | 720                | 0.375               | 0.01                | 650                | 0.035               |
| 2015-010-015  | 16,500                             | 650                | 210                   | 0.035               | 1.3                 | 650                | 0.035               | 1.3                 | 1,440              | 0.75                | 0.01                | 650                | 0.035               |
| 2015-010-030  | 16,500                             | 650                | 210                   | 0.035               | 1.3                 | 650                | 0.035               | 1.3                 | 720                | 0.375               | 0.01                | 650                | 0.035               |
| 2020-003-020  | 15,000                             | 360                | 180                   | 0.02                | 1.8                 | 360                | 0.02                | 1.8                 | 1,440              | 1                   | 0.01                | 720                | 0.05                |
| 2020-003-040  | 15,000                             | 360                | 180                   | 0.02                | 1.8                 | 360                | 0.02                | 1.8                 | 1,440              | 1                   | 0.01                | 720                | 0.05                |
| 2020-005-020  | 15,000                             | 720                | 240                   | 0.05                | 1.8                 | 720                | 0.05                | 1.8                 | 1,440              | 1                   | 0.01                | 720                | 0.05                |
| 2020-005-040  | 15,000                             | 720                | 240                   | 0.05                | 1.8                 | 720                | 0.05                | 1.8                 | 1,440              | 1                   | 0.01                | 720                | 0.05                |
| 2020-010-020  | 15,000                             | 720                | 240                   | 0.05                | 1.8                 | 720                | 0.05                | 1.8                 | 1,440              | 1                   | 0.01                | 720                | 0.05                |
| 2020-010-040  | 15,000                             | 720                | 240                   | 0.05                | 1.8                 | 720                | 0.05                | 1.8                 | 1,440              | 1                   | 0.01                | 720                | 0.05                |

These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (TAS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only.

Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials.

For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

※Feed Rate2: Feed rate of approach and \*connection moves.  
\*Changing from one engagement point to the next.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

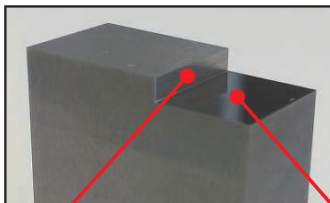
**Note:**

- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Does not require to be slowed down in the approach sequence when slotting and side milling.
- Use an inclined or helical approach when Z-level milling (Recommended inclination angle: <1 degree).
- For flat and side milling, set the axial depth (ap) and radial depth (ae) to allow for the uncut material of the corner radius.
- Decrease both spindle speed and feed rate proportionally.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

|                                   |        |
|-----------------------------------|--------|
| <p>Ø3mm Shank<br/>V Series</p>    |        |
| <p>UDC-PCD<br/>Series</p>         |        |
| <p>CBN<br/>Series</p>             |        |
| <p>Square</p>                     | Square |
| <p>Long Neck<br/>Square</p>       |        |
| <p>Radius</p>                     | Radius |
| <p>Long Neck<br/>Radius</p>       |        |
| <p>Taper Neck<br/>Radius</p>      |        |
| <p>Ball / Long<br/>Shank Ball</p> | Ball   |
| <p>Long Neck<br/>Ball</p>         |        |
| <p>Taper Neck<br/>Ball</p>        |        |
| <p>Taper</p>                      | Taper  |
| <p>Barrel</p>                     |        |
| <p>Spiral<br/>V Cutter</p>        |        |
| <p>Drill</p>                      |        |
| <p>Technical Data</p>             |        |

Cemented Carbide Milling Example UDCLRS 2020-005-020 ( $\phi 2 \times CR0.05 \times 2$ ) VM-40 (90HRA)

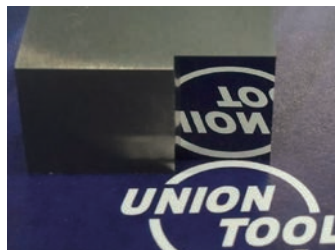
Work sample after finishing



Ra : 0.069  $\mu\text{m}$   
Rz : 0.535  $\mu\text{m}$   
Cut-off length : 0.25 mm

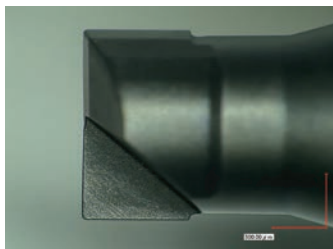
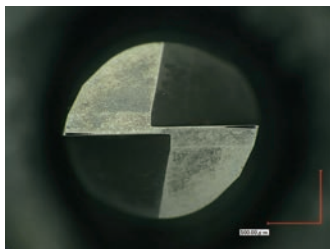
Ra : 0.010  $\mu\text{m}$  (10 nm)  
Rz : 0.078  $\mu\text{m}$  (78 nm)  
Cut-off length: 0.08 mm

Bottom Surface Quality



Mirror surface finish  
with zero pits!

After Finishing

UDCLRS  
Side Milling Video

| Milling Conditions      | Roughing Parameter       | Finishing Parameter   |
|-------------------------|--------------------------|---|
| Spindle Speed           | 20,000 min <sup>-1</sup> | 20,000 min <sup>-1</sup>                                      |
| XY Feed Rate            | 750 mm/min               | 100 mm/min  |
| $a_p$                   | 0.9 mm                   | 0.01 mm Bottom Surface<br>0.9 mm Side                         |
| $a_e$                   | 0.01 mm                  | 0.01 mm   |
| Coolant                 | Air Blow                 | Oil Mist  |
| Milling Size            | 10 × 8 × 1.8 mm          | 0.01 mm Bottom Surface<br>0.05 mm Side<br>(0.01 mm × 5 times) |
| Milling Distance        | 16 m                     | —   |
| Material Removal Volume | 144 mm <sup>3</sup>      | —   |

\* One End Mill was used for both the roughing and finishing processes.

Overhang : 15 mm

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 2 \sim \phi 6$



# UDCRRS



**NEW**

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           |                 |          |        | ○        |                       |                 | ★                     | ●                |                                       |

\* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glass, etc.

Total 4 models

Unit (mm)

| Model Number        | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Number of Flutes | Suggested Retail Price ¥ |
|---------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|------------------|--------------------------|
| UDCRRS 6020-020-050 | 2                         | RO.2             | 5                         | 1.6                  | 1.77                     | 16°                   | 50               | 4                       | 6                | 42,800                   |
| UDCRRS 6030-020-075 | 3                         | RO.2             | 7.5                       | 2.4                  | 2.77                     | 16°                   | 60               | 6                       | 6                | 45,960                   |
| UDCRRS 6040-020-100 | 4                         | RO.2             | 10                        | 3.2                  | 3.77                     | 16°                   | 60               | 6                       | 6                | 45,960                   |
| UDCRRS 10060-020150 | 6                         | RO.2             | 15                        | 4.8                  | 5.77                     | 16°                   | 60               | 6                       | 10               | 48,370                   |

## High Efficiency

6 flutes, 10 flutes with a 40° helix angle help to reduce cutting load allowing for deep milling on axial depth.

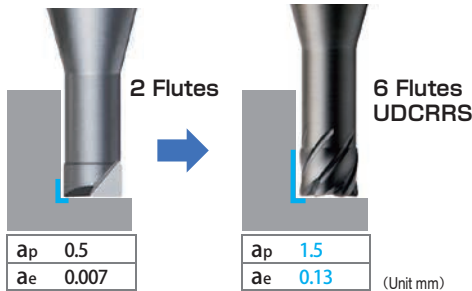
$\phi 2 \sim \phi 4$   
6 Flutes



$\phi 6$   
10 Flutes

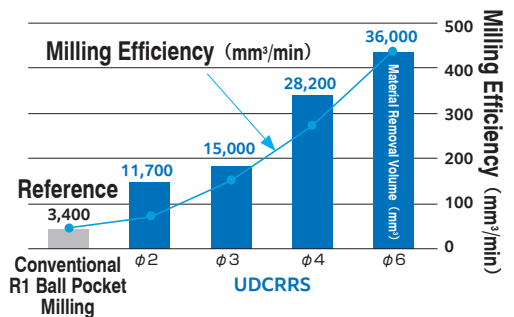


### Milling amount compared with 2 Flutes ( $\phi 2 \times EL 6$ )

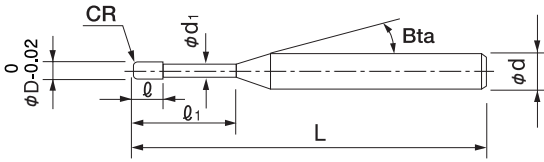


Compared to a tool with 2 flutes, the  $a_p$  is 3 times and the  $a_e$  18 times higher in comparison. This shows a significant efficiency improvement.

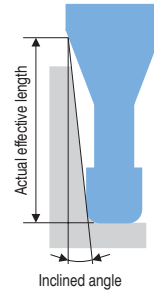
### Cutting material removal volume for each size



Milling efficiency and material removal volume exceeds the conventional tool.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



Unit (mm)

| Model Number        | Outside Diameter φD | Corner Radius CR | Effective Length ℓ <sub>i</sub> | Effective Length by Inclined Angles |                 |                 |                 |                 |
|---------------------|---------------------|------------------|---------------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|                     |                     |                  |                                 | 30'                                 | 1°              | 1° 30'          | 2°              | 3°              |
| UDCRRS 6020-020-050 | 2                   | RO.2             | 5                               | 5.52                                | 5.70            | 5.88            | 6.08            | 6.52            |
| UDCRRS 6030-020-075 | 3                   | RO.2             | 7.5                             | 8.10                                | 8.36            | 8.63            | 8.92            | 9.58            |
| UDCRRS 6040-020-100 | 4                   | RO.2             | 10                              | 10.68                               | 11.02           | 11.38           | 11.77           | 12.64           |
| UDCRRS 10060-020150 | 6                   | RO.2             | 15                              | No Interference                     | No Interference | No Interference | No Interference | No Interference |

## Roughing Conditions for UDCRRS

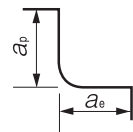
| WORK MATERIAL |                       | CEMENTED CARBIDE (≥87HRA) / HARD BRITTLE MATERIALS |                     |                     |                     |                     |                     |                     | CEMENTED CARBIDE (<87HRA)          |                     |                     |                     |                     |                     |                     |
|---------------|-----------------------|--|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )                 | Flat milling        |                     |                     | Side milling        |                     |                     | Spindle Speed (min <sup>-1</sup> ) | Flat milling        |                     |                     | Side milling        |                     |                     |
|               |                       |  | *Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | *Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |                                    | *Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | *Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |
| 6020-020-050  | 2                     | 20,000   | 375                 | 0.1                 | 0.8                 | 375                 | 1.5                 | 0.13                | 10,000                             | 375                 | 0.1                 | 0.8                 | 1,440               | 1.5                 | 0.02                |
| 6030-020-075  | 3                     | 17,500   | 375                 | 0.1                 | 1.2                 | 375                 | 2.2                 | 0.19                | 6,700                              | 375                 | 0.1                 | 1.2                 | 1,610               | 2.2                 | 0.02                |
| 6040-020-100  | 4                     | 15,000   | 375                 | 0.1                 | 1.6                 | 375                 | 3                   | 0.25                | 5,000                              | 375                 | 0.1                 | 1.6                 | 1,780               | 3                   | 0.02                |
| 10060-020150  | 6                     | 10,000   | 375                 | 0.2                 | 1                   | 375                 | 4                   | 0.3                 | 3,300                              | 375                 | 0.2                 | 1                   | 2,000               | 4                   | 0.02                |

\*Set the feed rate of approach and connecting points (changing from one engagement point to the next) to 100 mm/min.

Roughing with UDCRRS



Finishing with UDC 2 Flutes



\*UDCRRS is designed for roughing, use other UDC 2 flutes when finishing.

These milling parameters are based on VF-20, VM-40, VC-70, VU-70 (TAS standard) for Cemented Carbide, and Alumina for Hard Brittle Materials. These are for reference only.

Tool life may differ depending on the type of Cemented Carbide / Hard Brittle Materials.

For best result, fine parameter adjustments may be required, depending on the materials of Cemented Carbide / Hard Brittle Materials; milling shape and strategy; machine rigidity and spindle capability.

6 Flutes

10 Flutes

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Square

Long Neck Square

Radius

Radius

Radius

Long Neck Radius

Taper Neck Radius

Radius

Ball / Long Shank Ball

Ball

Long Neck Ball

Taper Neck Ball

Taper

Taper

Barrel

Barrel

Spiral V Cutter

Spiral V Cutter

Drill

Drill

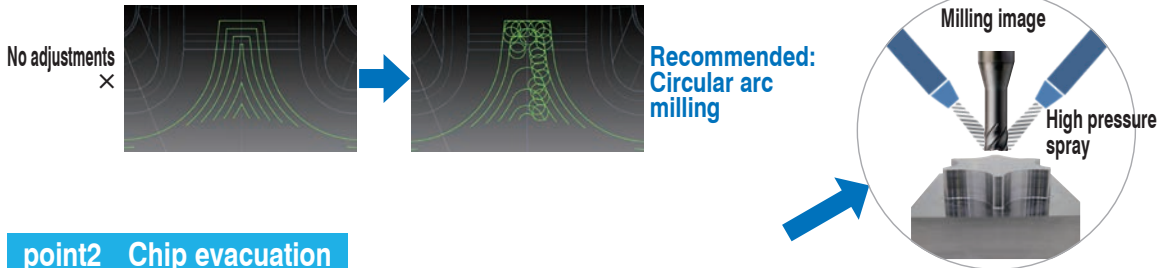
Technical Data

Technical Data

## The best way to use UDCRRS for high efficiency and long tool life

### point1 Circular arc milling

**Circular arc milling** is recommended so the returning point is not an acute angle. This reduces cutting load on the peripheral cutting edge.



### point2 Chip evacuation

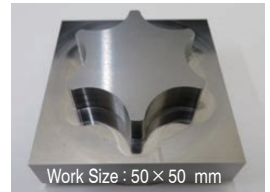
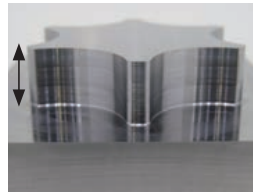
**Air blow coolant** is recommended. Recommended **spraying from multiple directions at high pressure** as much as possible.

Cemented Carbide Milling example of punching die  
UDCRRS  $\phi 4 \times CRO.2 \times EL10$

VM-40 (90HRA)

|               |                          |
|---------------|--------------------------|
| Spindle Speed | 15,000 min <sup>-1</sup> |
| Feed Rate     | 375 mm/min               |
| $a_p$         | 3 mm                     |
| $a_e$         | 0.25 mm                  |
| Coolant       | Air Blow                 |
| Cycle Time    | 93 min                   |

Depth 9 mm  
 $a_p$  3 mm  $\times$  3 times



Tool after milling



Milling volume 15,953 mm<sup>3</sup> with a single tool in 93 min.  
Tool damage is limited and continuous cutting is possible.

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

- Note:
- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
  - Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
  - Tool setting length should achieve the least possible overhang.
  - Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
  - Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
  - Decrease both spindle speed and feed rate proportionally.
  - Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
  - Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
  - When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
  - Remove chips to prevent heat generation and ignition during milling process.
  - Protective gear, such as safety glasses and face guards are required when milling.
  - Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.
  - The tool life may shorten due to a large difference between the commanded feed speed and the actual machining speed caused by factors as machining model and machining machine.
  - Tool damage may progress rapidly near the end of the tool life.

6 Flutes

10 Flutes

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.2 \sim \phi 2$

# UPDLRS



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material |                 |                    |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|---------------|-----------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels | Alloy Steels    | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|               |                 |                    | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| S45C<br>S55C  | SK / SCM<br>SUS | NAK<br>HPM         |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       | ★                | ●                                     |

## Features

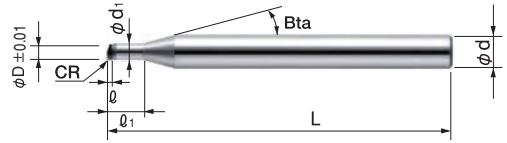
**Long Neck Radius End Mills for finishing of Cemented Carbide and Hard Brittle Materials.**  
 Provides excellent machined surface quality due to the sharp cutting edge and optimized edge treatment.  
 Maintains excellent dimensional accuracy for a long time due to the high contour accuracy of the cutting edge and the excellent wear resistance of diamonds.

Label Sample



#001  $\phi D 0.499$  R0.049/0.048

Diameter and Ball R accuracy measurements are printed on the label to support high precision milling.



Be sure to confirm the interference between the inclined work piece and the shank part by actual measurement.

Total 12 models

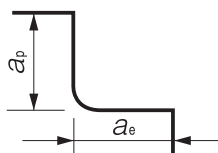
Unit (mm)

| Model Number        | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|---------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| UPDLRS 1002-002-006 | 0.2                       | R0.02            | 0.6                       | 0.1                  | 0.175                    | 16°                   | 40               | 4                       | Open price               |
| UPDLRS 1002-005-006 |                           | R0.05            |                           |                      |                          |                       |                  |                         | Open price               |
| UPDLRS 1003-002-010 | 0.3                       | R0.02            | 1                         | 0.15                 | 0.27                     | 16°                   | 40               | 4                       | Open price               |
| UPDLRS 1003-005-010 |                           | R0.05            |                           |                      |                          |                       |                  |                         | Open price               |
| UPDLRS 1005-005-015 | 0.5                       | R0.05            | 1.5                       | 0.25                 | 0.47                     | 16°                   | 40               | 4                       | Open price               |
| UPDLRS 1005-010-015 |                           | R0.1             |                           |                      |                          |                       |                  |                         | Open price               |
| UPDLRS 1010-005-030 | 1                         | R0.05            | 3                         | 0.55                 | 0.95                     | 16°                   | 40               | 4                       | Open price               |
| UPDLRS 1010-010-030 |                           | R0.1             |                           |                      |                          |                       |                  |                         | Open price               |
| UPDLRS 1010-020-030 |                           | R0.2             |                           |                      |                          |                       |                  |                         | Open price               |
| UPDLRS 1020-005-040 | 2                         | R0.05            | 4                         | 0.55                 | 1.95                     | 16°                   | 40               | 4                       | Open price               |
| UPDLRS 1020-010-040 |                           | R0.1             |                           |                      |                          |                       |                  |                         | Open price               |
| UPDLRS 1020-020-040 |                           | R0.2             |                           |                      |                          |                       |                  |                         | Open price               |



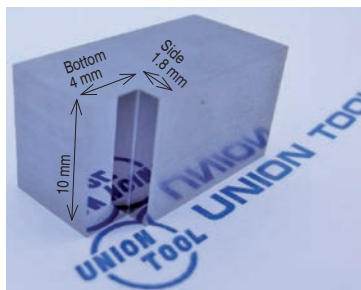
## Milling Conditions for UPDLRS

| WORK MATERIAL |                       |                       | CEMENTED CARBIDE                   |                    |            |            |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|------------|------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) |
| 1002-002-006  | 0.2                   | 0.6                   | 40,000                             | 100                | 0.001      | 0.001      |
| 1002-005-006  |                       |                       | 40,000                             | 100                | 0.001      | 0.001      |
| 1003-002-010  | 0.3                   | 1                     | 40,000                             | 150                | 0.002      | 0.001      |
| 1003-005-010  |                       |                       | 40,000                             | 150                | 0.002      | 0.001      |
| 1005-005-015  | 0.5                   | 1.5                   | 40,000                             | 200                | 0.003      | 0.001      |
| 1005-010-015  |                       |                       | 40,000                             | 200                | 0.003      | 0.001      |
| 1010-005-030  | 1                     | 3                     | 40,000                             | 400                | 0.005      | 0.003      |
| 1010-010-030  |                       |                       | 40,000                             | 400                | 0.005      | 0.003      |
| 1010-020-030  |                       |                       | 40,000                             | 400                | 0.005      | 0.003      |
| 1020-005-040  | 2                     | 4                     | 40,000                             | 600                | 0.01       | 0.005      |
| 1020-010-040  |                       |                       | 40,000                             | 600                | 0.01       | 0.005      |
| 1020-020-040  |                       |                       | 40,000                             | 600                | 0.01       | 0.005      |



- Note:
- Use a machine with high accuracy for stable cutting.
  - Non-water soluble coolant recommended. Supply as a mist or external coolant. Take fire prevention precautions to avoid fire hazards caused by sparks igniting during machining or tool breakage.
  - Shorten overhang as much as possible.
  - Adjust cutting conditions as necessary as machine spec and other conditions may vary.
  - These cutting parameters show reference value. Adjust the cutting conditions to the desired machined surface finish.

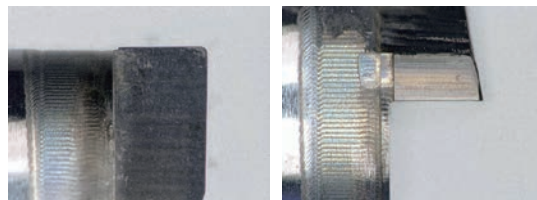
## Cemented Carbide UPDLRS Milling Example for Finishing UDCLRSF / UPDLRS $\phi 2$ VF-20 (92.5HRA)



Milling Area :  $4 \times 10 \times$  Depth 1.8 mm

Work Size :  $10 \times 10 \times 20$  mm

After Finishing



| Milling Process    | Tool  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm)           | $a_e$ (mm) | Stock (mm) | Coolant  | Cycle Time |
|--------------------|---|------------------------------------|--------------------|----------------------|------------|------------|----------|------------|
| Roughing           | UDCLRSF 2020-005020 ( $\phi 2 \times CR0.05 \times EL2$ ) | 20,000                             | 400                | $0.9 \times 2$ Times | 0.01       | 0.005      | Air Blow | 54 min     |
| Finishing (Bottom) | UPDLRS 1020-005-040 ( $\phi 2 \times CR0.05 \times EL4$ ) | 40,000                             | 600                | 0.01                 | 0.005      | 0          |          | 45 min     |
| Finishing (Side)   |   | 40,000                             | 400                | 0.002                | 0.01       | 0          |          | 52 min     |

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Square

Long Neck  
Square

Radius

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Ball  
Long Neck  
Ball

Taper Neck  
Ball

Taper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.3 \sim \phi 7$



# UDCMX



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       | ★                | ●<br>*                                |

\* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses and etc.

### Features

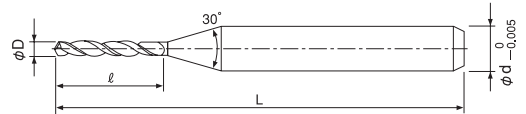
UDC offers excellent drilling performance on Cemented Carbide and Hard Brittle (Non-Metallic) Materials. By combining the new coating with optimum tool geometry, the tool improves hole quality and longer tool life. Makes mechanical drilling cost competitive!

Label Sample



#001  $\phi D5.999$

Measured diameter is printed on the label.



Point Angle : 130°

Diameter Tolerance : 0/-0.02 ( $D \leq 3.5$ )  
0/-0.025 ( $D \geq 4$ )

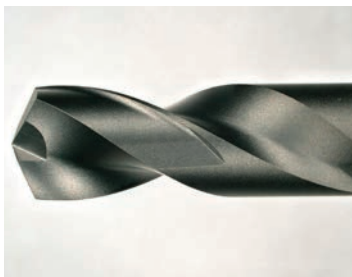
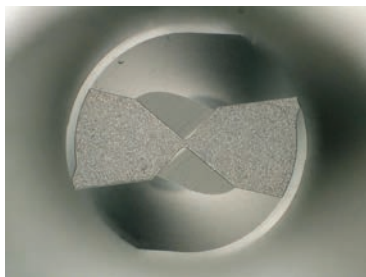
Under-cut type

Enlarged tip drawing

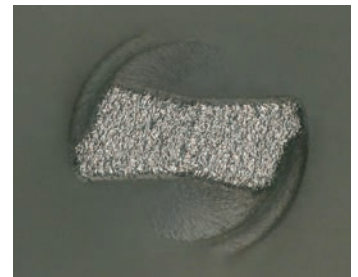


$\phi 0.4 \sim \phi 7$

2 facet relief + "X" thinning  
Designed for better biting



$\phi 0.3$  or below  
Contact us for the request of below  $\phi 0.3$ .



- $\phi 3$ mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Total 35 models

Unit (mm)

| Model Number   | Diameter<br>$\phi D$ | Flute Length<br>$\ell$ | Overall Length<br>L | Shank Diameter<br>$\phi d$ | Suggested Retail Price<br>¥ | Cemented Carbide                      |                       |                     |
|----------------|----------------------|------------------------|---------------------|----------------------------|-----------------------------|---------------------------------------|-----------------------|---------------------|
|                |                      |                        |                     |                            |                             | Spindle Speed<br>(min <sup>-1</sup> ) | Feed Rate<br>(mm/min) | Peck Amount<br>(mm) |
| UDCMX 2030-030 | 0.3                  | 3                      | 38                  | 3                          | 18,000                      | 28,750                                | 5                     | 0.05                |
| UDCMX 2040-040 | 0.4                  | 4                      | 38                  | 3                          | 18,000                      | 20,000                                | 5                     | 0.05                |
| UDCMX 2050-050 | 0.5                  | 5                      | 38                  | 3                          | 18,000                      | 15,000                                | 5                     | 0.05                |
| UDCMX 2060-060 | 0.6                  | 6                      | 38                  | 3                          | 18,000                      | 11,500                                | 5                     | 0.05                |
| UDCMX 2070-070 | 0.7                  | 7                      | 38                  | 3                          | 18,000                      | 9,000                                 | 5                     | 0.05                |
| UDCMX 2080-080 | 0.8                  | 8                      | 38                  | 3                          | 18,000                      | 7,300                                 | 7.5                   | 0.05                |
| UDCMX 2090-090 | 0.9                  | 9                      | 38                  | 3                          | 18,000                      | 6,000                                 | 7.5                   | 0.05                |
| UDCMX 2100-100 | 1                    | 10                     | 38                  | 3                          | 18,000                      | 5,000                                 | 7.5                   | 0.05                |
| UDCMX 2110-100 | 1.1                  | 10                     | 38                  | 3                          | 18,000                      | 4,500                                 | 7.2                   | 0.06                |
| UDCMX 2120-100 | 1.2                  | 10                     | 38                  | 3                          | 18,000                      | 4,100                                 | 6.8                   | 0.07                |
| UDCMX 2130-100 | 1.3                  | 10                     | 38                  | 3                          | 18,000                      | 3,750                                 | 6.5                   | 0.08                |
| UDCMX 2140-100 | 1.4                  | 10                     | 38                  | 3                          | 18,000                      | 3,450                                 | 6.2                   | 0.09                |
| UDCMX 2150-100 | 1.5                  | 10                     | 38                  | 3                          | 18,000                      | 3,200                                 | 6                     | 0.1                 |
| UDCMX 2160-100 | 1.6                  | 10                     | 38                  | 3                          | 18,000                      | 3,000                                 | 6                     | 0.1                 |
| UDCMX 2170-100 | 1.7                  | 10                     | 38                  | 3                          | 18,000                      | 2,850                                 | 5.8                   | 0.1                 |
| UDCMX 2180-100 | 1.8                  | 10                     | 38                  | 3                          | 18,000                      | 2,700                                 | 5.5                   | 0.1                 |
| UDCMX 2190-100 | 1.9                  | 10                     | 38                  | 3                          | 18,000                      | 2,550                                 | 5.3                   | 0.1                 |
| UDCMX 2200-100 | 2                    | 10                     | 38                  | 3                          | 18,000                      | 2,400                                 | 5                     | 0.15                |
| UDCMX 2210-100 | 2.1                  | 10                     | 38                  | 3                          | 18,000                      | 2,300                                 | 5                     | 0.15                |
| UDCMX 2220-100 | 2.2                  | 10                     | 38                  | 3                          | 18,000                      | 2,225                                 | 5                     | 0.15                |
| UDCMX 2230-100 | 2.3                  | 10                     | 38                  | 3                          | 18,000                      | 2,150                                 | 5                     | 0.15                |
| UDCMX 2240-100 | 2.4                  | 10                     | 38                  | 3                          | 18,000                      | 2,075                                 | 5                     | 0.15                |
| UDCMX 2250-100 | 2.5                  | 10                     | 38                  | 3                          | 18,000                      | 2,000                                 | 5                     | 0.2                 |
| UDCMX 2300-100 | 3                    | 10                     | 38                  | 3                          | 18,000                      | 1,100                                 | 3.7                   | 0.25                |
| UDCMX 2330-120 | 3.3                  | 12                     | 50                  | 4                          | 20,000                      | 1,000                                 | 3.4                   | 0.3                 |
| UDCMX 2350-120 | 3.5                  | 12                     | 50                  | 4                          | 20,000                      | 910                                   | 3.3                   | 0.35                |
| UDCMX 2400-160 | 4                    | 16                     | 60                  | 6                          | 35,500                      | 4,000                                 | 6.9                   | Single-Shot         |
| UDCMX 2420-160 | 4.2                  | 16                     | 60                  | 6                          | 35,500                      | 4,000                                 | 7.3                   | Single-Shot         |
| UDCMX 2450-200 | 4.5                  | 20                     | 60                  | 6                          | 35,500                      | 4,000                                 | 7.8                   | Single-Shot         |
| UDCMX 2500-200 | 5                    | 20                     | 60                  | 6                          | 35,500                      | 4,000                                 | 8.7                   | Single-Shot         |
| UDCMX 2550-250 | 5.5                  | 25                     | 80                  | 6                          | 38,000                      | 4,000                                 | 9.6                   | Single-Shot         |
| UDCMX 2600-250 | 6                    | 25                     | 80                  | 6                          | 38,000                      | 4,000                                 | 10.5                  | Single-Shot         |
| UDCMX 2650-250 | 6.5                  | 25                     | 80                  | 8                          | 48,000                      | 4,000                                 | 11.5                  | Single-Shot         |
| UDCMX 2680-250 | 6.8                  | 25                     | 80                  | 8                          | 52,000                      | 4,000                                 | 12                    | Single-Shot         |
| UDCMX 2700-250 | 7                    | 25                     | 80                  | 8                          | 52,000                      | 4,000                                 | 12.4                  | Single-Shot         |

These milling parameters are based on VM-40 (TAS standard) and are for reference only.

Tool life may differ depending on the type of Cemented Carbide material.

For best results, fine parameter adjustments may be required, depending on the Carbide material; milling shape and strategy; machine rigidity and spindle capability.

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball  
Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

**Note:**

- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Recommend shallower drilling than flute length to promote good chip evacuation.
- Recommend using peck drilling cycle, but single-shot drilling may extend the tool life in some cases.
- Recommend air blow.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.
- Peck drilling is required depending on the hole quality & hole-edge chipping.
- We recommend to avoid operating the machine unattended when using large size tools with high MRR (Material Removal Rate) per hole. Rapid tool wear, sudden tool damage or breakage might occur depending on the processing environment.
- When milling some work pieces, heavier chips may be created.  
To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.

ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

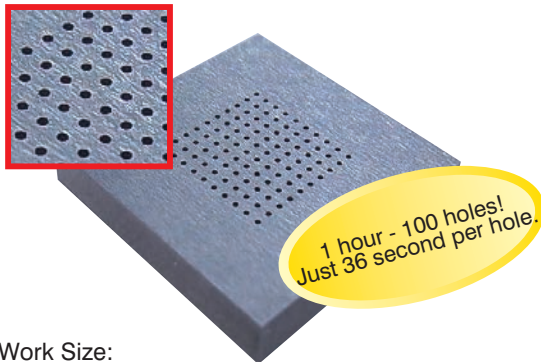
Spiral  
V Cutter

Drill

Technical Data

## Drilling Cemented Carbide - Stunning!

**Cemented Carbide One-shot drilled with UDCMX  $\phi 0.4 \times 4$  mm VM-40 (90HRA)**



**Work Size:**  
20 × 20 × 3 mm

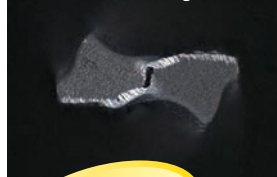
**Hole Quality after drilling 100 holes**



Good hole  
accuracy

|                    |  |
|--------------------|--|
| Tool               | UDCMX 2040-040                           |
| Spindle Speed      | 20,000 min <sup>-1</sup>                 |
| Feed Rate          | 5 mm/min                                 |
| Peck Amount        | One-shot                                 |
| Coolant            | Air Blow (Nozzle)                        |
| Hole Specification | Blind Hole<br>(Depth 2.8 mm × 100 holes) |
| Hole Pitch         | 1 mm                                     |
| Cycle Time         | 36 sec per hole                          |

**Tool wear after drilling 100 holes**



More tool life left!

UDCMX  
Drilling Video



## Cemented Carbide

Drilling with UDCMX  $\phi$  6.8 x Slot Length 25 mm >> Thread milling with UDCT M8

VM-40 (90HRA)

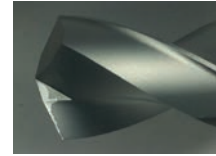
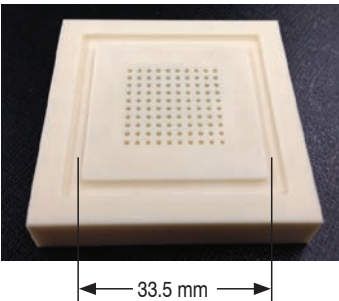


Work size :  
50 x 50 x 25 mm

| Milling Method     | Drilling (one-shot)                     | Thread milling         |
|--------------------|---|------------------------|
| Tool               | UDCMX<br>$\phi$ 6.8 x Slot Length 25 mm | UDCT<br>M8-1.25-24     |
| Spindle Speed      | 4,000 mm <sup>-1</sup>                  | 3,500 mm <sup>-1</sup> |
| Feed Rate          | 12 mm/min                               | 20 mm/min              |
| Overhang Length    | 35 mm                                   | 30 mm                  |
| Coolant            | Air Blow (Nozzle)                       |                        |
| Hole Specification | Blind hole<br>Depth 20 mm x 25 holes    | Depth 17.5 mm x 1 hole |
| Cycle Time         | 1 min 56 sec per hole                   | 5 min 36 sec per hole  |

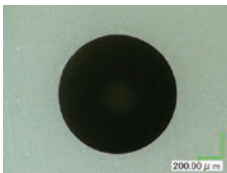


- UDCMX  $\phi$  6.8 : Drilled 25 holes with a single tool.
- More tool life left after drilling the 25th hole.
- Total material removal amount is about 17,000 mm<sup>3</sup> when the cycle time is less than 1 hour.

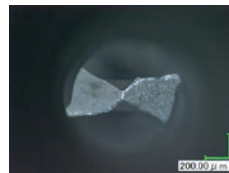
Hard Brittle Materials Drilling with UDCMX  $\phi$  1 x Slot Length 10 mmAluminum Al<sub>2</sub>O<sub>3</sub>

|                         |  |
|-------------------------|--|
| Spindle Speed           | 5,000 min <sup>-1</sup>                                    |
| Feed Rate               | 7.5 mm/min   |
| Peck Amount             | 0.05 mm  |
| Coolant                 | Water Soluble  |
| Hole Specification      | Blind hole Depth 9 mm x 100 holes                          |
| Material Removal Amount | 100 holes 700 mm <sup>3</sup><br>7mm <sup>3</sup> per hole |
| Cycle Time              | 100 holes 8 h 46 min<br>5 min 16 sec per hole              |

100th drilled hole  
No edge chipping



Drill tip after  
drilling 100 holes.



$\phi$ 3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size M2~M8



# UDCT



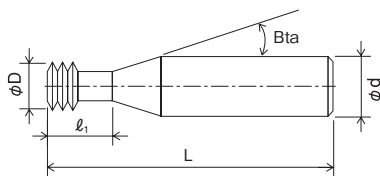
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       | ★                | ●                                     |

\* Hard Brittle (Non-Metallic) Materials: Ceramics (Alumina, Zirconia, etc.), Glasses etc.

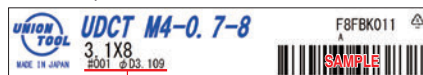
## Features

**Thread Mills for Cemented Carbide and Hard Brittle (Non-Metallic) Materials.**  
**Direct milling offers higher efficiency and precision comparing to EDM and grinding process.**  
**Developed to give improved hardness and durability, UDC also has outstanding adhesion to the tool.**  
**UDC series End Mills and Drills are recommended to drill holes before threading.**



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Label Sample



#001 φD3.109

Measured diameter is printed on the label.

Total 10 models

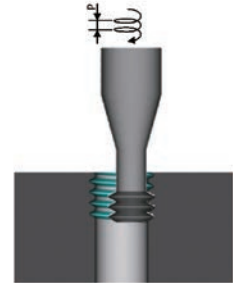
Unit (mm)

| Model Number     | Thread Diameter M | Pitch P | Tool Diameter φD | Number of Flutes | Effective Length $l_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter φd | Suggested Retail Price ¥ |
|------------------|-------------------|---------|------------------|------------------|------------------------|-----------------------|------------------|-------------------|--------------------------|
| UDCT M2-0.4-4    | M2                | 0.4     | 1.5              | 2                | 4                      | 16°                   | 50               | 4                 | 38,900                   |
| UDCT M2.5-0.45-5 | M2.5              | 0.45    | 1.9              | 2                | 5                      | 16°                   | 50               | 4                 | 38,900                   |
| UDCT M3-0.5-6    | M3                | 0.5     | 2.4              | 2                | 6                      | 16°                   | 50               | 4                 | 38,900                   |
| UDCT M4-0.7-8    | M4                | 0.7     | 3.1              | 2                | 8                      | 16°                   | 50               | 4                 | 38,900                   |
| UDCT M5-0.8-10   | M5                | 0.8     | 3.9              | 2                | 10                     | 16°                   | 60               | 6                 | 42,800                   |
| UDCT M5-0.8-15   |                   |         |                  |                  | 15                     |                       | 60               |                   | 6                        |
| UDCT M6-1-12     | M6                | 1       | 4.6              | 2                | 12                     | 16°                   | 60               | 6                 | 42,800                   |
| UDCT M6-1-18     |                   |         |                  |                  | 18                     |                       | 60               |                   | 6                        |
| UDCT M8-1.25-16  | M8                | 1.25    | 5.9              | 2                | 16                     | 16°                   | 60               | 6                 | 42,800                   |
| UDCT M8-1.25-24  |                   |         |                  |                  | 24                     |                       | 60               |                   | 6                        |



## Milling Conditions for UDCT

| Model Number | WORK MATERIAL     |         |                        | CEMENTED CARBIDE       |                                      |                                   |                    |
|--------------|-------------------|---------|------------------------|------------------------|--------------------------------------|-----------------------------------|--------------------|
|              | Thread Diameter M | Pitch P | Tool Diameter $\phi D$ | Effective Length $l_1$ | Recommended Pilot Hole Diameter (mm) | Spindle Speed (mm <sup>-1</sup> ) | Feed Rate (mm/min) |
| M2-0.4-4     | M2                | 0.4     | 1.5                    | 4                      | $\phi 1.6$                           | 20,000                            | 3                  |
| M2.5-0.45-5  | M2.5              | 0.45    | 1.9                    | 5                      | $\phi 2.1$                           | 20,000                            | 3                  |
| M3-0.5-6     | M3                | 0.5     | 2.4                    | 6                      | $\phi 2.5$                           | 20,000                            | 3                  |
| M4-0.7-8     | M4                | 0.7     | 3.1                    | 8                      | $\phi 3.3$                           | 10,050                            | 30                 |
| M5-0.8-10    | M5                | 0.8     | 3.9                    | 10                     | $\phi 4.2$                           | 8,000                             | 30                 |
| M5-0.8-15    |                   |         |                        | 15                     |                                      |                                   |                    |
| M6-1-12      | M6                | 1       | 4.6                    | 12                     | $\phi 5$                             | 6,800                             | 30                 |
| M6-1-18      |                   |         |                        | 18                     |                                      |                                   |                    |
| M8-1.25-16   | M8                | 1.25    | 5.9                    | 16                     | $\phi 6.8$                           | 3,500                             | 20                 |
| M8-1.25-24   |                   |         |                        | 24                     |                                      |                                   |                    |



\* Revised and reduced the spindle speed and feed rate for better tool life.

\* These milling parameters are based on VM-40 (TAS standard) and are for reference only.

Tool life may differ depending on the type of Cemented Carbide material.

For best results, fine parameter adjustments may be required, depending on the Carbide material; milling shape and strategy; machine rigidity and spindle capability.

### Note:

- This application requires a high cutting force. A machine with poor rigidity and high vibration is not recommended.
- Use a machine equipped with helical interpolating functions.
- Allow sufficient machine and spindle warm-up time for stability and to remove any expansion of the main spindle before running the program.
- Tool setting length should achieve the least possible overhang.
- Avoid contact with the coated area of the shank. This will prevent tip vibration and tool jamming in the collet / holder.
- Run-out and vibration should be checked dynamically at the tool point while mounted in the machine and both should achieve the lowest level possible.
- Decrease both spindle speed and feed rate proportionally.
- The feed rate is measured at the center of the tool.
- The radial cutting depth is recommended to cut all at once. Do not cut several times.
- Adjust turning radius amount to meet required internal thread precision.
- Air blow is highly recommended for longer tool life. Both oil mist and oil coolant are alternatives.
- Recommend water soluble coolant for Hard Brittle (Non-Metallic) Materials.
- When milling some work pieces, heavier chips may be created. To evacuate these chips it is important to accurately position the coolant nozzle on the milling part.
- Remove chips to prevent heat generation and ignition during milling process.
- Protective gear, such as safety glasses and face guards are required when milling.
- Chips / dust generated while milling can have adverse affects on the machine parts if they are not properly evacuated. Take steps to assure proper evacuation.

## "Direct Drilling & Thread Milling" on Cemented Carbide!!

Cemented Carbide UDCMX  $\phi 2.5$  (Hole Before Threading) + UDCT M3 (Thread Milling) VM-40(90HRA)

After drilling Holes  
before threading



After thread milling



Work Size:  
20 × 20 × 10 mm

|                    | Hole Before Threading               | Thread Milling           |
|--------------------|-------------------------------------|--------------------------|
| Tool               | UDCMX 2250-100                      | UDCT M3-0.5-6            |
| Spindle Speed      | 2,000 min <sup>-1</sup>             | 20,000 min <sup>-1</sup> |
| Feed Rate          | 5 mm/min                            | 3 mm/min                 |
| Peck Amount        | 0.5 mm                              | —                        |
| Coolant            | Air Blow (Nozzle)                   |                          |
| Hole Specification | Blind Hole<br>Depth 8 mm x 16 holes | Depth 6 mm x 16 holes    |
| Cycle Time         | 2 min 2 sec per hole                | 9 min 15 sec per hole    |

## New standard for Cemented Carbide Processing

- Cracks are minimized.
- Time and cost savings comparing to EDM process.
- Highly precise thread geometry generated by single path threading.

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data





# *CBN Series*

*CBN End Mills UNIMAX Series*



# The 2 features of UNIMAX CBN series

## Various lineup of tools

2 types each for Ball and Radius.  
**SF** series offers shiny milling surfaces.

|              | Long Neck Ball       |                      |                 | Long Neck Radius     |                 |                 |
|--------------|----------------------|----------------------|-----------------|----------------------|-----------------|-----------------|
| Type         | Super mirror surface | Super surface finish | Long tool life  | Super surface finish | Long tool life  |                 |
| Series       | CBN-PLB              | CBN-LBSF             | CBN-LBF         | CBN-RSF              | CBN-LRF 2000    | CBN-LRF 4000    |
| Flutes       | 2 Flutes             | 2 Flutes             | 2 Flutes        | 1 Flute              | 2 Flutes        | 4 Flutes        |
| Helix angle  | Non helix angle      | Helix angle 20°      | Non helix angle | Non helix angle      | Non helix angle | Non helix angle |
| Tip geometry |                      |                      |                 |                      |                 |                 |
| Page         | 120                  | 122                  | 126             | 132                  | 136             | 146             |

## High precision milling

Industry-leading high precision.  
 The tool measurements are printed on the label to support High Precision milling.

|                | Long Neck Ball       |                      |                                  | Long Neck Radius                  |                |              |
|----------------|----------------------|----------------------|----------------------------------|-----------------------------------|----------------|--------------|
| Type           | Super mirror surface | Super surface finish | Long tool life                   | Super surface finish              | Long tool life |              |
| Series         | CBN-PLB              | CBN-LBSF             | CBN-LBF                          | CBN-RSF                           | CBN-LRF 2000   | CBN-LRF 4000 |
| R/CR Tolerance |                      |                      |                                  |                                   |                |              |
| Label sample   | R tolerance          | R tolerance          | R tolerance / Diameter tolerance | CR tolerance / Diameter tolerance |                |              |
|                |                      |                      |                                  |                                   |                |              |

# For super surface finish The features of CBN series

CBN-LBSF, CBN-RSF for super surface finish.  
SF series offers shiny milling surfaces.

The power of **SF**

Ball

## Milling surface comparison of Ball type



**ELMAX (60HRC)**  
Size :  $\phi 5 \times$  Depth 2.5 mm

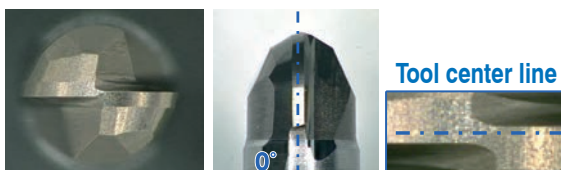
|               |                          |
|---------------|--------------------------|
| Tool Size     | R0.5 $\times$ EL1.5      |
| Spindle Speed | 30,000 min <sup>-1</sup> |
| Feed Rate     | 750 mm/min               |
| Cusp Height   | 0.0001 mm                |
| Coolant       | Oil Mist                 |

### CBN-LBSF For super surface finish



A cutting edge is set at the tip of the tool (zero peripheral speed).  
Improved finishing surface by the burnishing effect on relief.

### CBN-LBF For long tool life



Non helix angle design ensures high rigidity.

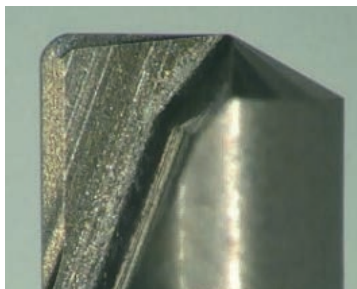
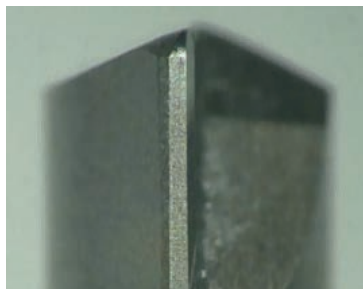
Radius

## Tool features of Radius type

### CBN-RSF For super surface finish



1 flute design enables an even milling amount and prevents chip biting caused by runout.  
The tool relief rubs against the milling surface to create a burnished finish.



$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.2~R0.5

# CBN-PLB



Patent pending

NEW

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 | ○                                | ●               | ●      | ●      | ●      | ●      |           |                 |          |        |          |                       |                 |                       |                  |                                       |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

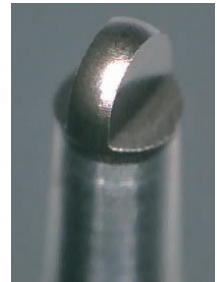
Spiral V Cutter

Drill

Technical Data

## Features

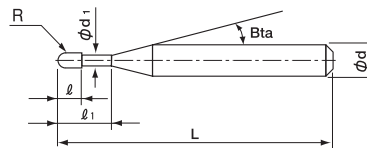
1. CBN material featuring very high wear resistance.
2. Burnishing effect enables super mirror milling!
3. The slot design that allows coolant to reach the cutting edge.  
Chip evacuation effect offers long tool life.  
Prevention of repetitive chip cutting offers uniform milling surfaces.



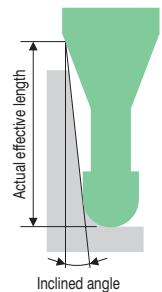
Label Sample



Ball Radius accuracy measurements are printed on the label to support High Precision milling.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



Total 3 models

Unit (mm)

| Model Number     | Radius of Ball Nose R | Effective Length ℓ <sub>1</sub> | Length of Cut ℓ | Neck Diameter φ <sub>d1</sub> | Shank Taper Angle Bta | Overall Length L | Shank Diameter φ <sub>d</sub> | Suggested Retail Price ¥ | Effective Length by Inclined Angles |      |       |      |      |
|------------------|-----------------------|---------------------------------|-----------------|-------------------------------|-----------------------|------------------|-------------------------------|--------------------------|-------------------------------------|------|-------|------|------|
|                  |                       |                                 |                 |                               |                       |                  |                               |                          | 30°                                 | 1°   | 1°30' | 2°   | 3°   |
| CBN-PLB 2004-010 | R0.2                  | 1                               | 0.24            | 0.38                          | 15°                   | 50               | 4                             | 32,800                   | 1.03                                | 1.06 | 1.09  | 1.13 | 1.21 |
| CBN-PLB 2006-015 | R0.3                  | 1.5                             | 0.36            | 0.58                          | 15°                   | 50               | 4                             | 30,800                   | 1.53                                | 1.57 | 1.62  | 1.68 | 1.79 |
| CBN-PLB 2010-025 | R0.5                  | 2.5                             | 0.6             | 0.98                          | 15°                   | 50               | 4                             | 30,800                   | 2.57                                | 2.64 | 2.72  | 2.81 | 3.00 |

## Milling Conditions for CBN-PLB

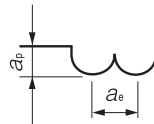
| WORK MATERIAL |                          |                       | HEAT-TREATED STEELS / HARDENED STEELS<br>STAVAX / ELMAX / HAP10 / HAP72<br>(~70HRC) |                    |                        |                         |
|---------------|--------------------------|-----------------------|---|--------------------|------------------------|-------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2004-010      | R0.2                     | 1                     | 30,000  | 150                | 0.001                  | 0.001                   |
| 2006-015      | R0.3                     | 1.5                   | 30,000  | 300                | 0.002                  | 0.002                   |
| 2010-025      | R0.5                     | 2.5                   | 30,000  | 375                | 0.003                  | 0.003                   |

Tool shape



Length of cut

The length of cut that is 1.2 times the ball radius enables finishing on vertical surfaces.



Note:

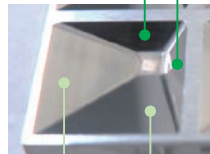
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Recommend oil mist to avoid tool damage.

## Inclined surface milling 2 Flutes CBN-PLB R0.5 × EL2.5

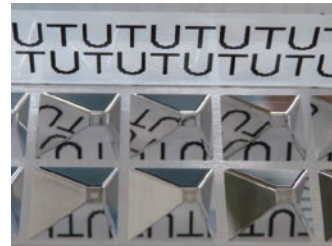
ELMAX (60HRC)

|                |                          |
|----------------|--------------------------|
| Process        | Finishing                |
| Coolant        | Oil Mist                 |
| Milling Method | Contour milling          |
| Spindle Speed  | 30,000 min <sup>-1</sup> |
| Feed Rate      | 375 mm/min               |
| Allowance      | 0.003 mm                 |
| Cycle Time     | 1 pocket 1 h 30 min      |

45° Inclined Surface

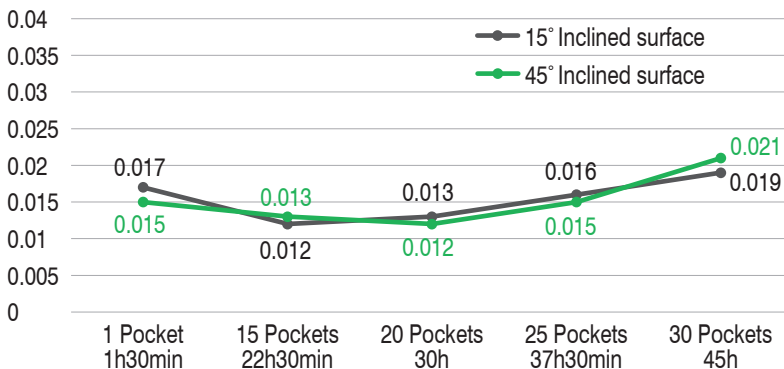


15° Inclined Surface

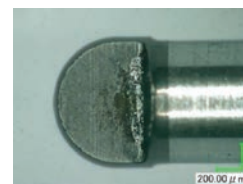
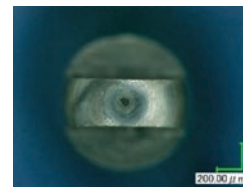


Surface roughness  
15° Ra 0.014 μm  
45° Ra 0.018 μm

### Milling time and transition of Ra (Unit: μm)



Only subtle difference in surface roughness after 45 hours.



Tool after 45h of milling

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.05~R1

# CBN-LBSF



Patented in Japan, China, Taiwan and Korea

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

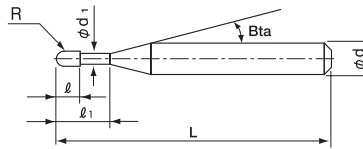
| Work Material |                 |                    |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|---------------|-----------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels | Alloy Steels    | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|               |                 |                    | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| S45C<br>S55C  | SK / SCM<br>SUS | NAK<br>HPM         | ○               | ●      | ●      | ●      | ●      |           |                 |          |        |          |                       |                 |                       |                  |                                       |

Label Sample

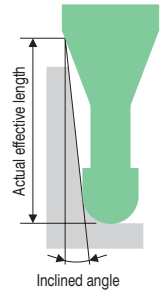


#001 R1 R+0.001/0.000

Ball Radius accuracy measurements are printed on the label to support High Precision milling.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



## Features

For higher precision and better surface finish  
Ball radius accuracy  $\pm 0.002\text{mm}$  based on Nominal Radius.



A cutting edge is set at the tip of the tool (zero peripheral speed). Less tool damage and improved finishing surface.

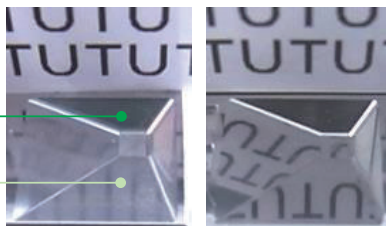
## Inclined surface milling CBN-LBF & CBN-LBSF comparison

ELMAX (60.5HRC)

Pocket Size : 9 × 9 × Depth 1.5 mm

45° Inclined Surface

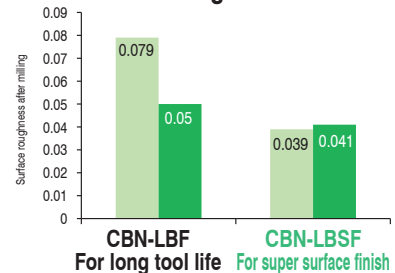
15° Inclined Surface



CBN-LBF  
For long tool life

CBN-LBSF  
For super surface finish

## Surface Roughness after milling



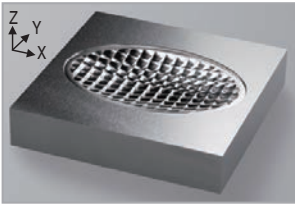
| Milling method         | Spindle Speed            | Feed Rate  | Allowance | Cusp height | Coolant  | Cycle Time |
|------------------------|--------------------------|------------|-----------|-------------|----------|------------|
| Contour spiral milling | 30,000 min <sup>-1</sup> | 550 mm/min | 0.005 mm  | 0.0001 mm   | Oil mist | 21.5 min   |



## Lens application

### 2 Flutes CBN-LBSF R0.3 × EL1 · R1 × EL3

HAP10 (64HRC)



### Surface Roughness after milling

| Measurement point      | Ra (μm) |
|------------------------|---------|
| Front point of Y axis  | 0.0272  |
| Center point of Y axis | 0.0172  |
| Back point of Y axis   | 0.0304  |

CBN-LBSF  
Milling video

Work Size : 100 × 100 × 20 mm  
Coolant : Oil mist, Oil coolant

Shiny surface

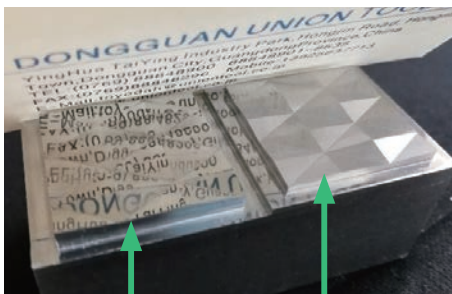
| No. | Process                   | Tool                | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Allowance (mm) | Cycle Time (h:m) |
|-----|---------------------------|---------------------|------------------------------------|--------------------|---------------------|---------------------|----------------|------------------|
| 1   | Roughing                  | HGB R2              | 9,480                              | 2,400              | 0.18                | 0.75                | 0.08           | 1:01             |
| 2   | Lens part/Semi-roughing   |                     | 9,480                              | 2,400              | 0.18                | 0.375               | 0.05           | 0:06             |
| 3   | Periphery/Semi-roughing   | HGB R1              | 14,700                             | 2,160              | 0.1                 | 0.35                | 0.05           | 0:07             |
| 4   | Periphery/Semi-finishing1 |                     | 14,700                             | 2,160              | 0.1                 | 0.1                 | 0.02           | 0:03             |
| 5   | Lens part/Semi-finishing1 |                     | 14,700                             | 2,160              | 0.03                | 0.1                 | 0.02           | 0:36             |
| 6   | Periphery/Semi-finishing2 | HGB R0.5            | 21,000                             | 1,750              | 0.04                | 0.04                | 0.005          | 0:15             |
| 7   | Lens part/Semi-finishing2 | HGB R1              | 14,700                             | 2,160              | 0.015               | 0.05                | 0.005          | 1:13             |
| 8   | Periphery/Finishing       | CBN-LBSF R0.3 × EL1 | 30,000                             | 600                | 0.01                | 0.01                | 0              | 2:56             |
| 9   | Lens part/Finishing       | CBN-LBSF R1 × EL3   | 24,000                             | 750                | 0.005               | 0.018               | 0              | 4:52             |

Total 11:09

## CBN-LBF/CBN-LBSF Surface roughness comparison

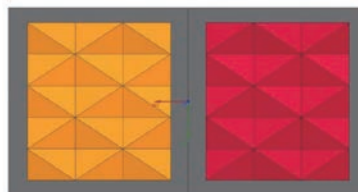
### 2 Flutes R0.5 × EL1.5

STAVAX (52HRC)



CBN-LBSF  
For super surface  
Ra 0.033 μm

CBN-LBF  
For long tool life  
Ra 0.159 μm



Size : 55 × 25 × 23 mm  
Coolant : Oil mist

| Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Cycle Time (h:m) |
|------------------------------------|--------------------|---------------------|---------------------|------------------|
| 36,000                             | 600                | 0.003               | 0.008               | 2:17             |

CBN-LBSF is recommended for excellent milling surface.  
The surface finish is of such high quality that the letters reflect perfectly in it.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## 2 Flutes CBN Long Neck Ball End Mills for Super Finishing

Total 36 models

Shank taper angle Bta is only for reference

Unit (mm)

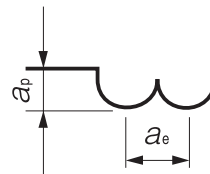
| Model Number        | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |       |       |
|---------------------|-----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|-------|-------|
|                     |                       |                           |                      |                          |                       |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°    | 3°    |
| CBN-LBSF 2001-003   | RO.05                 | 0.3                       | 0.07                 | 0.09                     | 15°                   | 50               | 4                       | 46,700                   | 0.30                                | 0.30  | 0.30  | 0.30  | 0.33  |
| CBN-LBSF 2001-005   |                       | 0.5                       |                      |                          |                       |                  |                         |                          | 0.50                                | 0.50  | 0.51  | 0.53  | 0.57  |
| CBN-LBSF 20015-0045 | RO.075                | 0.45                      | 0.1                  | 0.14                     | 15°                   | 50               | 4                       | 46,700                   | 0.45                                | 0.45  | 0.46  | 0.48  | 0.51  |
| CBN-LBSF 20015-0075 |                       | 0.75                      |                      |                          |                       |                  |                         |                          | 0.75                                | 0.76  | 0.78  | 0.81  | 0.88  |
| CBN-LBSF 2002-003   | RO.1                  | 0.3                       | 0.13                 | 0.19                     | 15°                   | 50               | 4                       | 35,000                   | 0.30                                | 0.30  | 0.30  | 0.30  | 0.32  |
| CBN-LBSF 2002-006   |                       | 0.6                       |                      |                          |                       |                  |                         |                          | 0.60                                | 0.60  | 0.62  | 0.64  | 0.69  |
| CBN-LBSF 2003-005   | RO.15                 | 0.5                       | 0.22                 | 0.28                     | 15°                   | 50               | 4                       | 33,900                   | 0.51                                | 0.53  | 0.54  | 0.56  | 0.60  |
| CBN-LBSF 2003-0075  |                       | 0.75                      |                      |                          |                       |                  |                         |                          | 0.77                                | 0.79  | 0.82  | 0.85  | 0.91  |
| CBN-LBSF 2003-009   |                       | 0.9                       |                      |                          |                       |                  |                         |                          | 0.91                                | 0.94  | 0.97  | 1.01  | 1.08  |
| CBN-LBSF 2004-0075  | RO.2                  | 0.75                      | 0.32                 | 0.38                     | 15°                   | 50               | 4                       | 30,600                   | 0.77                                | 0.79  | 0.81  | 0.84  | 0.90  |
| CBN-LBSF 2004-010   |                       | 1                         |                      |                          |                       |                  |                         |                          | 1.03                                | 1.06  | 1.09  | 1.13  | 1.21  |
| CBN-LBSF 2004-012   |                       | 1.2                       |                      |                          |                       |                  |                         |                          | 1.22                                | 1.26  | 1.30  | 1.35  | 1.44  |
| CBN-LBSF 2005-010   | RO.25                 | 1                         | 0.4                  | 0.48                     | 15°                   | 50               | 4                       | 31,200                   | 1.01                                | 1.04  | 1.07  | 1.11  | 1.18  |
| CBN-LBSF 2005-015   |                       | 1.5                       |                      |                          |                       |                  |                         |                          | 1.53                                | 1.58  | 1.63  | 1.68  | 1.80  |
| CBN-LBSF 2006-010   | RO.3                  | 1                         | 0.48                 | 0.58                     | 15°                   | 50               | 4                       | 28,700                   | 1.01                                | 1.04  | 1.07  | 1.10  | 1.17  |
| CBN-LBSF 2006-015   |                       | 1.5                       |                      |                          |                       |                  |                         |                          | 1.53                                | 1.57  | 1.62  | 1.68  | 1.79  |
| CBN-LBSF 2006-020   |                       | 2                         |                      |                          |                       |                  |                         |                          | 2.05                                | 2.11  | 2.18  | 2.25  | 2.41  |
| CBN-LBSF 2008-020   | RO.4                  | 2                         | 0.6                  | 0.78                     | 15°                   | 50               | 4                       | 29,300                   | 2.04                                | 2.10  | 2.17  | 2.24  | 2.39  |
| CBN-LBSF 2008-040   |                       | 4                         |                      |                          |                       |                  |                         |                          | 4.11                                | 4.24  | 4.38  | 4.54  | 4.88  |
| CBN-LBSF 2010-015   |                       | 1.5                       |                      |                          |                       |                  |                         |                          | 1.53                                | 1.57  | 1.61  | 1.66  | 1.76  |
| CBN-LBSF 2010-020   | RO.5                  | 2                         | 0.7                  | 0.98                     | 15°                   | 50               | 4                       | 28,700                   | 2.05                                | 2.11  | 2.17  | 2.23  | 2.38  |
| CBN-LBSF 2010-025   |                       | 2.5                       |                      |                          |                       |                  |                         |                          | 2.57                                | 2.64  | 2.72  | 2.81  | 3.00  |
| CBN-LBSF 2010-030   |                       | 3                         |                      |                          |                       |                  |                         |                          | 3.09                                | 3.18  | 3.28  | 3.38  | 3.62  |
| CBN-LBSF 2010-040   |                       | 4                         |                      |                          |                       |                  |                         |                          | 4.12                                | 4.25  | 4.38  | 4.53  | 4.87  |
| CBN-LBSF 2010-060   |                       | 6                         |                      |                          |                       |                  |                         |                          | 6.19                                | 6.39  | 6.60  | 6.83  | 7.35  |
| CBN-LBSF 2015-025   | RO.75                 | 2.5                       | 0.9                  | 1.46                     | 15°                   | 50               | 4                       | 30,000                   | 2.60                                | 2.67  | 2.74  | 2.81  | 2.99  |
| CBN-LBSF 2015-030   |                       | 3                         |                      |                          |                       |                  |                         |                          | 3.12                                | 3.20  | 3.29  | 3.39  | 3.61  |
| CBN-LBSF 2015-038   |                       | 3.8                       |                      |                          |                       |                  |                         |                          | 3.94                                | 4.06  | 4.18  | 4.31  | 4.61  |
| CBN-LBSF 2015-060   |                       | 6                         |                      |                          |                       |                  |                         |                          | 6.22                                | 6.41  | 6.62  | 6.84  | 7.34  |
| CBN-LBSF 2015-080   |                       | 8                         |                      |                          |                       |                  |                         |                          | 8.28                                | 8.55  | 8.83  | 9.14  | 9.83  |
| CBN-LBSF 2020-030   | R1                    | 3                         | 1.2                  | 1.97                     | 15°                   | 50               | 4                       | 30,500                   | 3.09                                | 3.16  | 3.24  | 3.33  | 3.53  |
| CBN-LBSF 2020-040   |                       | 4                         |                      |                          |                       |                  |                         |                          | 4.12                                | 4.23  | 4.35  | 4.48  | 4.77  |
| CBN-LBSF 2020-050   |                       | 5                         |                      |                          |                       |                  |                         |                          | 5.16                                | 5.30  | 5.46  | 5.63  | 6.01  |
| CBN-LBSF 2020-060   |                       | 6                         |                      |                          |                       |                  |                         |                          | 6.19                                | 6.37  | 6.57  | 6.78  | 7.26  |
| CBN-LBSF 2020-080   |                       | 8                         |                      |                          |                       |                  |                         |                          | 8.26                                | 8.51  | 8.79  | 9.08  | 9.74  |
| CBN-LBSF 2020-100   |                       | 10                        |                      |                          |                       |                  |                         |                          | 10.32                               | 10.65 | 11.00 | 11.38 | 12.23 |

- $\phi 3\text{mm}$  Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



## Milling Conditions for CBN-LBSF

| WORK MATERIAL |                          |                       | HEAT-TREATED STEELS / HARDENED STEELS<br>STAVAX / ELMAX / HAP10 / HAP72<br>(~68HRC) |                    |                           |                            |
|---------------|--------------------------|-----------------------|---|--------------------|---------------------------|----------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 2001-003      | R0.05                    | 0.3                   | 30,000  | 70                 | 0.003 MAX                 | 0.006 MAX                  |
| 2001-005      |                          | 0.5                   | 30,000  | 70                 | 0.002 MAX                 | 0.006 MAX                  |
| 20015-0045    | R0.075                   | 0.45                  | 30,000  | 150                | 0.004 MAX                 | 0.008 MAX                  |
| 20015-0075    |                          | 0.75                  | 30,000  | 125                | 0.004 MAX                 | 0.008 MAX                  |
| 2002-003      | R0.1                     | 0.3                   | 30,000  | 240                | 0.005 MAX                 | 0.01 MAX                   |
| 2002-006      |                          | 0.6                   | 30,000  | 200                | 0.005 MAX                 | 0.01 MAX                   |
| 2003-005      | R0.15                    | 0.5                   | 30,000  | 300                | 0.005 MAX                 | 0.01 MAX                   |
| 2003-0075     |                          | 0.75                  | 30,000  | 250                | 0.005 MAX                 | 0.01 MAX                   |
| 2003-009      |                          | 0.9                   | 30,000  | 250                | 0.005 MAX                 | 0.01 MAX                   |
| 2004-0075     | R0.2                     | 0.75                  | 30,000  | 360                | 0.005 MAX                 | 0.01 MAX                   |
| 2004-010      |                          | 1                     | 30,000  | 300                | 0.005 MAX                 | 0.01 MAX                   |
| 2004-012      |                          | 1.2                   | 30,000  | 300                | 0.005 MAX                 | 0.01 MAX                   |
| 2005-010      | R0.25                    | 1                     | 30,000  | 420                | 0.005 MAX                 | 0.01 MAX                   |
| 2005-015      |                          | 1.5                   | 30,000  | 350                | 0.005 MAX                 | 0.01 MAX                   |
| 2006-010      | R0.3                     | 1                     | 30,000  | 500                | 0.01 MAX                  | 0.015 MAX                  |
| 2006-015      |                          | 1.5                   | 30,000  | 500                | 0.01 MAX                  | 0.015 MAX                  |
| 2006-020      |                          | 2                     | 30,000  | 350                | 0.01 MAX                  | 0.015 MAX                  |
| 2008-020      | R0.4                     | 2                     | 30,000  | 620                | 0.01 MAX                  | 0.015 MAX                  |
| 2008-040      |                          | 4                     | 30,000  | 420                | 0.01 MAX                  | 0.015 MAX                  |
| 2010-015      |                          | 1.5                   | 30,000  | 750                | 0.01 MAX                  | 0.02 MAX                   |
| 2010-020      | R0.5                     | 2                     | 30,000  | 750                | 0.01 MAX                  | 0.02 MAX                   |
| 2010-025      |                          | 2.5                   | 30,000  | 750                | 0.01 MAX                  | 0.02 MAX                   |
| 2010-030      |                          | 3                     | 30,000  | 500                | 0.01 MAX                  | 0.02 MAX                   |
| 2010-040      |                          | 4                     | 30,000  | 500                | 0.01 MAX                  | 0.02 MAX                   |
| 2010-060      | R0.75                    | 6                     | 30,000  | 330                | 0.01 MAX                  | 0.02 MAX                   |
| 2015-025      |                          | 2.5                   | 20,000  | 750                | 0.01 MAX                  | 0.02 MAX                   |
| 2015-030      |                          | 3                     | 20,000  | 750                | 0.01 MAX                  | 0.02 MAX                   |
| 2015-038      |                          | 3.8                   | 20,000  | 750                | 0.01 MAX                  | 0.02 MAX                   |
| 2015-060      |                          | 6                     | 20,000  | 500                | 0.01 MAX                  | 0.02 MAX                   |
| 2015-080      | 8                        | 20,000                | 500   | 0.01 MAX           | 0.02 MAX                  |                            |
| 2020-030      | R1                       | 3                     | 15,000  | 750                | 0.01 MAX                  | 0.025 MAX                  |
| 2020-040      |                          | 4                     | 15,000  | 750                | 0.01 MAX                  | 0.025 MAX                  |
| 2020-050      |                          | 5                     | 15,000  | 750                | 0.01 MAX                  | 0.025 MAX                  |
| 2020-060      |                          | 6                     | 15,000  | 500                | 0.01 MAX                  | 0.025 MAX                  |
| 2020-080      |                          | 8                     | 15,000  | 500                | 0.01 MAX                  | 0.025 MAX                  |
| 2020-100      |                          | 10                    | 15,000  | 500                | 0.01 MAX                  | 0.025 MAX                  |



## Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Recommend oil mist to avoid tool damage.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.05~R2

# CBN-LBF



Additional 6 models

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

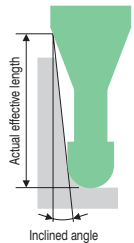
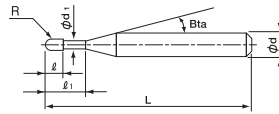
| Work Material |                 |                    |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|---------------|-----------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels | Alloy Steels    | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|               |                 |                    | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| S45C<br>S55C  | SK / SCM<br>SUS | NAK<br>HPM         | ○               | ●      | ●      | ●      | ●      |           |                 |          |        |          |                       |                 |                       |                  |                                       |

Label Sample



#001  $\phi$  D0.600 R+0.003/0.000

Diameter and Ball Radius accuracy measurements are printed on the label to support High Precision milling.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

## Features

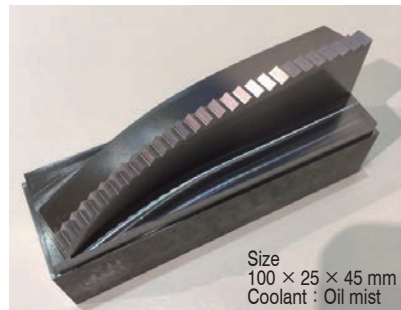
For long tool life  
Various lineup from R0.05 to R2.

Tool center line

Non helix angle design ensures high rigidity.

## Reflector mold finishing 2 Flutes CBN-LBF R0.15 × EL0.9

SKD11 (60HRC)



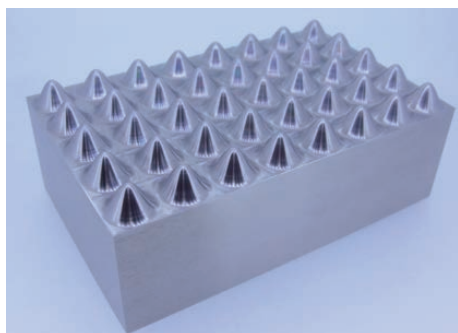
| No. | Tool                  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>o</sub> (mm) | a <sub>e</sub> (mm) | Cycle Time (h:m:s) |
|-----|-----------------------|------------------------------------|--------------------|---------------------|---------------------|--------------------|
| 1   | HSB R1.5              | 15,000                             | 800                | 0.06                | 0.06                | 0:25:37            |
| 2   | HSB R0.5              | 20,000                             | 500                | 0.025               | 0.025               | 1:11:53            |
| 3   | HSB R0.25             | 25,000                             | 350                | 0.02                | 0.02                | 0:34:29            |
| 4   | HSB R0.15             | 30,000                             | 300                | 0.015               | 0.015               | 0:30:55            |
| 5   | CBN-LBF R0.15 × EL0.9 | 30,000                             | 300                | 0.008               | 0.008               | 3:48:13            |

Total 6:31:07

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

**Convex shaped finishing**  
**2 Flutes CBN-LBF/CBN-LBSF R0.3 × EL1.5**

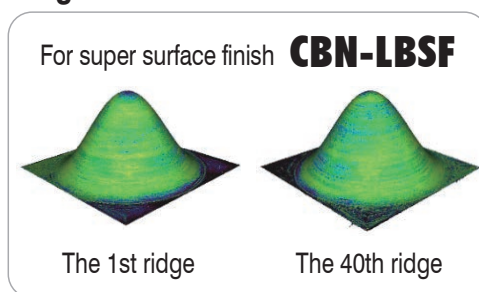
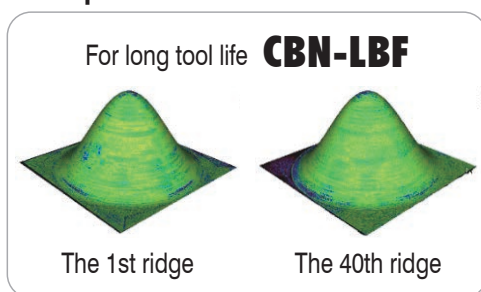
**STAVAX (52HRC)**



Work Size : 80 × 50 × 30 mm  
 Coolant : Oil mist

|                |                          |
|----------------|--------------------------|
| Process        | Finishing                |
| Milling Method | Contour spiral milling   |
| Spindle Speed  | 30,000 min <sup>-1</sup> |
| Feed Rate      | 800 mm/min               |
| Cusp Height    | 0.0001 mm                |
| $a_e$          | 0.015 mm                 |
| Cycle Time     | 9:48 h:m                 |

### Work piece dimensional error after milling



**Both types are able to mill for a long time while maintaining accuracy.**

Milling time 1 ridge : 12 min 30 sec, 40 ridges : 8 h 20 min,

### Milling surface comparison



**CBN-LBF for high efficiency milling and long tool life.**

**CBN-LBSF offers shiny milling surfaces.**

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Radius  
Taper Neck  
Radius

Ball / Long  
Shank Ball  
Long Neck  
Ball

Taper  
Taper

Barrel

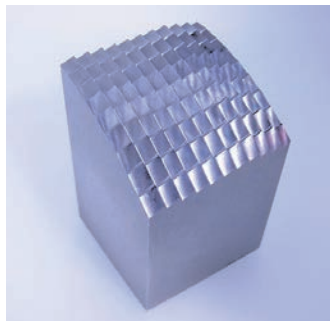
Spiral  
V Cutter

Drill

Technical Data

**Reflector mold finishing**  
**2 Flutes CBN-LBF R0.4 × EL2**

**STAVAX (52HRC)**



CBN-LBF  
 Milling video of  
 reflector mold for  
 finishing



| No | Process        | Tool                  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Cycle Time (h:m:s) |
|----|----------------|-----------------------|------------------------------------|--------------------|---------------------|---------------------|--------------------|
| 1  | Roughing       | HRRS φ6 × CR1 × EL18  | 3,500                              | 2,500              | 0.2                 | 2                   | 0:18:00            |
| 2  | Semi-roughing  | HRRS φ6 × CR1 × EL18  | 9,000                              | 2,500              | 0.05                | 0.1                 | 0:13:35            |
| 3  | Semi-roughing  | HRRS φ2 × CR0.3 × EL6 | 3,500                              | 1,000              | 0.04                | 1                   | 0:33:55            |
| 4  | Semi-finishing | HSB R1.5              | 12,000                             | 2,500              | 0.02                | 0.07                | 0:12:24            |
| 5  | Semi-finishing | HSB R0.75             | 7,000                              | 1,000              | 0.04                | 0.07                | 0:20:50            |
| 6  | Semi-finishing | HSB R0.75             | 7,000                              | 700                | 0.05                | 0.05                | 0:18:08            |
| 7  | Semi-finishing | HSB R0.5              | 8,000                              | 500                | 0.02                | 0.03                | 0:23:24            |
| 8  | Semi-finishing | HSB R0.5              | 15,000                             | 1,200              | 0.02                | 0.03                | 1:30:33            |
| 9  | Finishing      | CBN-LBF R0.4 × EL2    | 26,000                             | 800                | 0.01                | 0.004               | 10:12:54           |

Total 14:03:43

Total 64 models

\*Shank taper angle Bta is only for reference.

Unit (mm)

| Model Number       | Radius of Ball Nose R | Effective Length ℓ <sub>1</sub> | Length of Cut ℓ | Neck Diameter φ <sub>d</sub> | Shank Taper Angle Bta | Overall Length L | Shank Diameter φ <sub>d</sub> | Suggested Retail Price ¥ | Effective Length by Inclined Angles |      |       |      |      |      |      |      |      |      |
|--------------------|-----------------------|---------------------------------|-----------------|------------------------------|-----------------------|------------------|-------------------------------|--------------------------|-------------------------------------|------|-------|------|------|------|------|------|------|------|
|                    |                       |                                 |                 |                              |                       |                  |                               |                          | 30°                                 | 1°   | 1°30' | 2°   | 3°   |      |      |      |      |      |
| CBN-LBF 2001-003   | R0.05                 | 0.3                             | 0.08            | 0.09                         | 15°                   | 50               | 4                             | 42,400                   | 0.30                                | 0.30 | 0.30  | 0.30 | 0.33 |      |      |      |      |      |
| CBN-LBF 2001-005   |                       | 0.5                             |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 0.50 | 0.50 | 0.51 | 0.53 | 0.57 |
| CBN-LBF 20015-0045 | R0.075                | 0.45                            | 0.15            | 0.14                         | 15°                   | 50               | 4                             | 42,400                   | 0.45                                | 0.45 | 0.46  | 0.48 | 0.51 |      |      |      |      |      |
| CBN-LBF 20015-0075 |                       | 0.75                            |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 0.75 | 0.76 | 0.78 | 0.81 | 0.88 |
| CBN-LBF 2002-003   | R0.1                  | 0.3                             | 0.16            | 0.19                         | 15°                   | 50               | 4                             | 28,800                   | 0.30                                | 0.30 | 0.30  | 0.30 | 0.32 |      |      |      |      |      |
| CBN-LBF 2002-006   |                       | 0.6                             |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 0.60 | 0.60 | 0.62 | 0.64 | 0.69 |
| CBN-LBF 2002-010   |                       | 1                               |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 1.00 | 1.03 | 1.06 | 1.10 | 1.19 |
| CBN-LBF 2003-005   | R0.15                 | 0.5                             | 0.24            | 0.28                         | 15°                   | 50               | 4                             | 28,800                   | 0.51                                | 0.53 | 0.54  | 0.56 | 0.60 |      |      |      |      |      |
| CBN-LBF 2003-0075  |                       | 0.75                            |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 0.77 | 0.79 | 0.82 | 0.85 | 0.91 |
| CBN-LBF 2003-009   |                       | 0.9                             |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 0.91 | 0.94 | 0.96 | 1.00 | 1.06 |
| CBN-LBF 2003-015   |                       | 1.5                             |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 1.53 | 1.58 | 1.63 | 1.68 | 1.80 |
| CBN-LBF 2004-005   | R0.2                  | 0.5                             | 0.32            | 0.38                         | 15°                   | 50               | 4                             | 27,700                   | 0.51                                | 0.52 | 0.54  | 0.55 | 0.58 |      |      |      |      |      |
| CBN-LBF 2004-0075  |                       | 0.75                            |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 0.77 | 0.79 | 0.81 | 0.84 | 0.90 |
| CBN-LBF 2004-010   |                       | 1                               |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 1.03 | 1.06 | 1.09 | 1.13 | 1.21 |
| CBN-LBF 2004-012   |                       | 1.2                             |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 1.22 | 1.25 | 1.29 | 1.33 | 1.42 |
| CBN-LBF 2004-020   |                       | 2                               |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 2.04 | 2.10 | 2.17 | 2.24 | 2.40 |
| CBN-LBF 2004-030   | 3                     | 3.07                            | 3.17            | 3.27                         | 3.38                  | 3.62             |                               |                          |                                     |      |       |      |      |      |      |      |      |      |
| CBN-LBF 2005-010   | R0.25                 | 1                               | 0.4             | 0.48                         | 15°                   | 50               | 4                             | 27,700                   | 1.02                                | 1.05 | 1.08  | 1.12 | 1.19 |      |      |      |      |      |
| CBN-LBF 2005-015   |                       | 1.5                             |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 1.53 | 1.57 | 1.62 | 1.66 | 1.78 |
| CBN-LBF 2005-025   |                       | 2.5                             |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 2.56 | 2.63 | 2.72 | 2.80 | 3.00 |
| CBN-LBF 2005-035   |                       | 3.5                             |                 |                              |                       |                  |                               |                          |                                     |      |       |      |      | 3.59 | 3.70 | 3.82 | 3.94 | 4.22 |

Unit (mm)

| Model Number       | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |        |                 |
|--------------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|--------|-----------------|
|                    |                       |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°     | 3°              |
| CBN-LBF 2006-010   | RO.3                  | 1                      | 0.48              | 0.58                     | 15°                   | 50               | 4                       | 26,600                   | 1.02                                | 1.05  | 1.08  | 1.11   | 1.18            |
| CBN-LBF 2006-015   |                       | 1.5                    |                   |                          |                       | 50               | 4                       | 26,600                   | 1.52                                | 1.57  | 1.61  | 1.66   | 1.76            |
| CBN-LBF 2006-030   |                       | 3                      |                   |                          |                       | 50               | 4                       | 28,400                   | 3.07                                | 3.16  | 3.26  | 3.37   | 3.60            |
| CBN-LBF 2006-040   |                       | 4                      |                   |                          |                       | 50               | 4                       | 28,400                   | 4.10                                | 4.23  | 4.36  | 4.50   | 4.82            |
| CBN-LBF 2006-050   |                       | 5                      |                   |                          |                       | 50               | 4                       | 28,800                   | 5.13                                | 5.29  | 5.46  | 5.64   | 6.05            |
| CBN-LBF 2006-060   |                       | 6                      |                   |                          |                       | 50               | 4                       | 31,600                   | 6.17                                | 6.36  | 6.56  | 6.78   | 7.27            |
| CBN-LBF 2008-020   | RO.4                  | 2                      | 0.6               | 0.78                     | 15°                   | 50               | 4                       | 26,600                   | 2.04                                | 2.09  | 2.15  | 2.21   | 2.35            |
| CBN-LBF 2008-040   |                       | 4                      |                   |                          |                       | 50               | 4                       | 28,400                   | 4.10                                | 4.22  | 4.35  | 4.49   | 4.80            |
| CBN-LBF 2008-060   |                       | 6                      |                   |                          |                       | 50               | 4                       | 31,100                   | 6.16                                | 6.35  | 6.55  | 6.77   | 7.25            |
| CBN-LBF 2010-015   | RO.5                  | 1.5                    | 0.7               | 0.98                     | 15°                   | 50               | 4                       | 26,600                   | 1.53                                | 1.57  | 1.61  | 1.66   | 1.76            |
| CBN-LBF 2010-020   |                       | 2                      |                   |                          |                       | 50               | 4                       | 26,600                   | 2.05                                | 2.11  | 2.17  | 2.23   | 2.38            |
| CBN-LBF 2010-025   |                       | 2.5                    |                   |                          |                       | 50               | 4                       | 26,600                   | 2.56                                | 2.63  | 2.70  | 2.78   | 2.96            |
| CBN-LBF 2010-040   |                       | 4                      |                   |                          |                       | 50               | 4                       | 28,400                   | 4.11                                | 4.23  | 4.35  | 4.49   | 4.79            |
| CBN-LBF 2010-050   |                       | 5                      |                   |                          |                       | 50               | 4                       | 28,400                   | 5.14                                | 5.29  | 5.45  | 5.63   | 6.02            |
| CBN-LBF 2010-060   |                       | 6                      |                   |                          |                       | 50               | 4                       | 28,400                   | 6.17                                | 6.36  | 6.55  | 6.77   | 7.24            |
| CBN-LBF 2010-080   |                       | 8                      |                   |                          |                       | 50               | 4                       | 28,800                   | 8.23                                | 8.49  | 8.76  | 9.04   | 9.69            |
| CBN-LBF 2010-100   |                       | 10                     |                   |                          |                       | 50               | 4                       | 29,500                   | 10.30                               | 10.62 | 10.96 | 11.32  | 12.13           |
| CBN-LBF 2012-024   | RO.6                  | 2.4                    | 0.8               | 1.18                     | 15°                   | 50               | 4                       | 27,700                   | 2.46                                | 2.53  | 2.60  | 2.68   | 2.85            |
| CBN-LBF 2012-030   |                       | 3                      |                   |                          |                       | 50               | 4                       | 27,700                   | 3.08                                | 3.17  | 3.27  | 3.37   | 3.60            |
| CBN-LBF 2012-060   |                       | 6                      |                   |                          |                       | 50               | 4                       | 32,200                   | 6.18                                | 6.38  | 6.59  | 6.82   | 7.33            |
| CBN-LBF 2015-030   | RO.75                 | 3                      | 0.9               | 1.46                     | 15°                   | 50               | 4                       | 27,700                   | 3.12                                | 3.20  | 3.29  | 3.39   | 3.61            |
| CBN-LBF 2015-040   |                       | 4                      |                   |                          |                       | 50               | 4                       | 27,700                   | 4.15                                | 4.27  | 4.40  | 4.54   | 4.85            |
| CBN-LBF 2015-060   |                       | 6                      |                   |                          |                       | 50               | 4                       | 27,700                   | 6.22                                | 6.41  | 6.62  | 6.84   | 7.34            |
| CBN-LBF 2015-080   |                       | 8                      |                   |                          |                       | 50               | 4                       | 30,600                   | 8.28                                | 8.55  | 8.83  | 9.14   | 9.83            |
| CBN-LBF 2015-100   |                       | 10                     |                   |                          |                       | 50               | 4                       | 32,200                   | 10.35                               | 10.69 | 11.05 | 11.44  | 12.31           |
| CBN-LBF 2015-120   |                       | 12                     |                   |                          |                       | 50               | 4                       | 32,200                   | 12.42                               | 12.83 | 13.27 | 13.74  | 14.80           |
| CBN-LBF 2015-150   |                       | 15                     |                   |                          |                       | 50               | 4                       | 32,200                   | 15.52                               | 16.04 | 16.59 | 17.19  | 18.53           |
| CBN-LBF 2020-040   |                       | R1                     |                   |                          |                       | 4                | 1.2                     | 1.97                     | 15°                                 | 50    | 4     | 27,700 | 4.12            |
| CBN-LBF 2020-050   | 5                     |                        | 50                | 4                        | 27,700                | 5.16             |                         |                          |                                     | 5.30  | 5.46  | 5.63   | 6.01            |
| CBN-LBF 2020-060   | 6                     |                        | 50                | 4                        | 27,700                | 6.19             |                         |                          |                                     | 6.37  | 6.57  | 6.78   | 7.26            |
| CBN-LBF 2020-080   | 8                     |                        | 50                | 4                        | 30,600                | 8.26             |                         |                          |                                     | 8.51  | 8.79  | 9.08   | 9.74            |
| CBN-LBF 2020-100   | 10                    |                        | 50                | 4                        | 30,600                | 10.32            |                         |                          |                                     | 10.65 | 11.00 | 11.38  | 12.23           |
| CBN-LBF 2020-120   | 12                    |                        | 50                | 4                        | 32,200                | 12.39            |                         |                          |                                     | 12.79 | 13.22 | 13.68  | 14.72           |
| CBN-LBF 2020-140   | 14                    |                        | 50                | 4                        | 32,700                | 14.46            |                         |                          |                                     | 14.93 | 15.44 | 15.98  | 17.20           |
| CBN-LBF 2020-160   | 16                    |                        | 50                | 4                        | 32,700                | 16.53            |                         |                          |                                     | 17.07 | 17.65 | 18.28  | 19.69           |
| CBN-LBF 2020-180   | 18                    |                        | 50                | 4                        | 32,700                | 18.59            |                         |                          |                                     | 19.21 | 19.87 | 20.58  | No Interference |
| CBN-LBF 2020-200   | 20                    |                        | 50                | 4                        | 32,700                | 20.66            |                         |                          |                                     | 21.35 | 22.09 | 22.88  | No Interference |
| ※ CBN-LBF 2030-040 | R1.5                  | 4                      | 1.8               | 2.94                     | 15°                   | 50               | 6                       | 29,260                   | 4.16                                | 4.26  | 4.36  | 4.47   | 4.72            |
| ※ CBN-LBF 2030-060 |                       | 6                      |                   |                          |                       | 50               | 6                       | 29,260                   | 6.23                                | 6.40  | 6.58  | 6.77   | 7.21            |
| ※ CBN-LBF 2030-080 |                       | 8                      |                   |                          |                       | 50               | 6                       | 29,260                   | 8.30                                | 8.54  | 8.79  | 9.07   | 9.70            |
| ※ CBN-LBF 2040-060 | R2                    | 6                      | 2.4               | 3.95                     | 15°                   | 50               | 6                       | 35,320                   | 6.21                                | 6.36  | 6.52  | 6.70   | 7.09            |
| ※ CBN-LBF 2040-080 |                       | 8                      |                   |                          |                       | 50               | 6                       | 35,320                   | 8.28                                | 8.50  | 8.74  | 9.00   | 9.57            |
| ※ CBN-LBF 2040-100 |                       | 10                     |                   |                          |                       | 50               | 6                       | 35,320                   | 10.35                               | 10.64 | 10.96 | 11.30  | 12.06           |

※Additional model

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for CBN-LBF

| WORK MATERIAL |                          |                       | HEAT-TREATED STEELS / HARDENED STEELS<br>STAVAX<br>(~52HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10 / HAP72<br>(~68HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|--------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )           | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001-003      | R0.05                    | 0.3                   | 30,000  | 200                | 0.005                           | 0.005                            | 30,000                               | 150                | 0.003                           | 0.005                            | 30,000                                       | 100                | 0.002                           | 0.005                            |
| 2001-005      |                          | 0.5                   | 30,000  | 150                | 0.003                           | 0.005                            | 30,000                               | 120                | 0.003                           | 0.005                            | 30,000                                       | 90                 | 0.002                           | 0.005                            |
| 20015-0045    | R0.075                   | 0.45                  | 30,000  | 350                | 0.005                           | 0.005                            | 30,000                               | 270                | 0.004                           | 0.005                            | 30,000                                       | 200                | 0.003                           | 0.005                            |
| 20015-0075    |                          | 0.75                  | 30,000  | 220                | 0.004                           | 0.005                            | 30,000                               | 160                | 0.004                           | 0.005                            | 30,000                                       | 100                | 0.003                           | 0.005                            |
| 2002-003      | R0.1                     | 0.3                   | 30,000  | 660                | 0.005                           | 0.005                            | 30,000                               | 550                | 0.005                           | 0.005                            | 30,000                                       | 440                | 0.005                           | 0.005                            |
| 2002-006      |                          | 0.6                   | 30,000  | 500                | 0.005                           | 0.005                            | 30,000                               | 400                | 0.005                           | 0.005                            | 30,000                                       | 300                | 0.005                           | 0.005                            |
| 2002-010      |                          | 1                     | 30,000  | 290                | 0.005                           | 0.005                            | 30,000                               | 200                | 0.005                           | 0.005                            | 30,000                                       | 120                | 0.005                           | 0.005                            |
| 2003-005      | R0.15                    | 0.5                   | 30,000  | 1,000              | 0.005                           | 0.005                            | 30,000                               | 950                | 0.005                           | 0.005                            | 30,000                                       | 620                | 0.005                           | 0.005                            |
| 2003-0075     |                          | 0.75                  | 30,000  | 850                | 0.005                           | 0.005                            | 30,000                               | 800                | 0.005                           | 0.005                            | 30,000                                       | 500                | 0.005                           | 0.005                            |
| 2003-009      |                          | 0.9                   | 30,000  | 760                | 0.005                           | 0.005                            | 30,000                               | 600                | 0.005                           | 0.005                            | 30,000                                       | 430                | 0.005                           | 0.005                            |
| 2003-015      |                          | 1.5                   | 30,000  | 460                | 0.005                           | 0.005                            | 30,000                               | 320                | 0.005                           | 0.005                            | 30,000                                       | 190                | 0.005                           | 0.005                            |
| 2004-005      | R0.2                     | 0.5                   | 30,000  | 1,580              | 0.005                           | 0.01                             | 30,000                               | 1,330              | 0.005                           | 0.01                             | 30,000                                       | 860                | 0.005                           | 0.005                            |
| 2004-0075     |                          | 0.75                  | 30,000  | 1,390              | 0.005                           | 0.01                             | 30,000                               | 1,140              | 0.005                           | 0.01                             | 30,000                                       | 800                | 0.005                           | 0.005                            |
| 2004-010      |                          | 1                     | 30,000  | 1,200              | 0.005                           | 0.01                             | 30,000                               | 950                | 0.005                           | 0.01                             | 30,000                                       | 730                | 0.005                           | 0.005                            |
| 2004-012      |                          | 1.2                   | 30,000  | 1,050              | 0.005                           | 0.01                             | 30,000                               | 800                | 0.005                           | 0.01                             | 30,000                                       | 620                | 0.005                           | 0.005                            |
| 2004-020      |                          | 2                     | 30,000  | 600                | 0.005                           | 0.01                             | 30,000                               | 450                | 0.005                           | 0.01                             | 30,000                                       | 330                | 0.005                           | 0.005                            |
| 2004-030      | R0.25                    | 3                     | 20,000  | 400                | 0.005                           | 0.005                            | 20,000                               | 300                | 0.005                           | 0.005                            | 20,000                                       | 190                | 0.003                           | 0.003                            |
| 2005-010      |                          | 1                     | 30,000  | 1,600              | 0.01                            | 0.01                             | 30,000                               | 1,300              | 0.01                            | 0.01                             | 30,000                                       | 920                | 0.005                           | 0.01                             |
| 2005-015      |                          | 1.5                   | 30,000  | 1,300              | 0.01                            | 0.01                             | 30,000                               | 1,000              | 0.01                            | 0.01                             | 30,000                                       | 760                | 0.005                           | 0.01                             |
| 2005-025      |                          | 2.5                   | 30,000  | 800                | 0.01                            | 0.01                             | 30,000                               | 700                | 0.01                            | 0.01                             | 30,000                                       | 480                | 0.005                           | 0.01                             |
| 2005-035      |                          | 3.5                   | 22,000  | 550                | 0.01                            | 0.01                             | 22,000                               | 500                | 0.005                           | 0.01                             | 22,000                                       | 330                | 0.005                           | 0.005                            |
| 2006-010      | R0.3                     | 1                     | 30,000  | 2,400              | 0.02                            | 0.03                             | 30,000                               | 1,900              | 0.02                            | 0.03                             | 30,000                                       | 1,080              | 0.01                            | 0.02                             |
| 2006-015      |                          | 1.5                   | 30,000  | 2,000              | 0.02                            | 0.03                             | 30,000                               | 1,500              | 0.02                            | 0.03                             | 30,000                                       | 1,000              | 0.01                            | 0.02                             |
| 2006-030      |                          | 3                     | 26,000  | 1,100              | 0.02                            | 0.02                             | 26,000                               | 900                | 0.02                            | 0.02                             | 26,000                                       | 760                | 0.01                            | 0.01                             |
| 2006-040      |                          | 4                     | 22,000  | 750                | 0.01                            | 0.02                             | 22,000                               | 650                | 0.01                            | 0.02                             | 22,000                                       | 570                | 0.005                           | 0.01                             |
| 2006-050      |                          | 5                     | 18,000  | 550                | 0.01                            | 0.01                             | 18,000                               | 450                | 0.01                            | 0.01                             | 18,000                                       | 410                | 0.005                           | 0.005                            |
| 2006-060      |                          | 6                     | 12,000  | 350                | 0.005                           | 0.01                             | 12,000                               | 290                | 0.005                           | 0.005                            | 12,000                                       | 260                | 0.003                           | 0.003                            |
| 2008-020      |                          | R0.4                  | 2   | 30,000             | 2,500                           | 0.02                             | 0.03                                 | 30,000             | 2,100                           | 0.02                             | 0.03   | 30,000             | 1,700                           | 0.01                             |
| 2008-040      | 4                        |                       | 25,000  | 1,500              | 0.02                            | 0.02                             | 25,000                               | 1,350              | 0.02                            | 0.02                             | 25,000                                       | 1,200              | 0.01                            | 0.01                             |
| 2008-060      | 6                        |                       | 18,000  | 1,000              | 0.01                            | 0.02                             | 18,000                               | 800                | 0.01                            | 0.02                             | 18,000                                       | 750                | 0.005                           | 0.01                             |
| 2010-015      | R0.5                     |                       | 1.5   | 30,000             | 3,700                           | 0.04                             | 0.05                                 | 30,000             | 3,400                           | 0.03                             | 0.04   | 30,000             | 2,300                           | 0.025                            |
| 2010-020      |                          | 2                     | 30,000  | 3,500              | 0.04                            | 0.04                             | 30,000                               | 3,200              | 0.03                            | 0.04                             | 30,000                                       | 2,200              | 0.02                            | 0.03                             |
| 2010-025      |                          | 2.5                   | 30,000  | 3,300              | 0.04                            | 0.04                             | 30,000                               | 3,000              | 0.03                            | 0.04                             | 30,000                                       | 2,100              | 0.02                            | 0.03                             |
| 2010-040      |                          | 4                     | 27,000  | 2,700              | 0.03                            | 0.04                             | 27,000                               | 2,300              | 0.03                            | 0.03                             | 27,000                                       | 1,800              | 0.02                            | 0.02                             |
| 2010-050      |                          | 5                     | 23,000  | 2,200              | 0.03                            | 0.03                             | 23,000                               | 1,800              | 0.03                            | 0.03                             | 23,000                                       | 1,450              | 0.02                            | 0.02                             |
| 2010-060      |                          | 6                     | 20,000  | 1,900              | 0.02                            | 0.03                             | 20,000                               | 1,500              | 0.02                            | 0.03                             | 20,000                                       | 1,200              | 0.01                            | 0.02                             |
| 2010-080      |                          | 8                     | 14,000  | 1,300              | 0.01                            | 0.02                             | 14,000                               | 1,000              | 0.01                            | 0.02                             | 14,000                                       | 800                | 0.01                            | 0.01                             |
| 2010-100      |                          | 10                    | 9,000   | 800                | 0.01                            | 0.02                             | 9,000                                | 600                | 0.01                            | 0.01                             | 9,000  | 490                | 0.005                           | 0.005                            |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

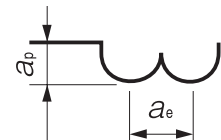
Technical Data

## Milling Conditions for CBN-LBF

| WORK MATERIAL |                          |                       | HEAT-TREATED STEELS / HARDENED STEELS<br>STAVAX<br>(~52HRC) |                    |                           |                            | HARDENED STEELS<br>SKD11<br>(~62HRC) |                    |                           |                            | HARDENED STEELS<br>HAP10 / HAP72<br>(~68HRC) |                    |                           |                            |
|---------------|--------------------------|-----------------------|---|--------------------|---------------------------|----------------------------|--------------------------------------|--------------------|---------------------------|----------------------------|--|--------------------|---------------------------|----------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )           | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 2012-024      | R0.6                     | 2.4                   | 30,000  | 3,000              | 0.05                      | 0.05                       | 29,500                               | 2,550              | 0.035                     | 0.04                       | 29,000                                       | 2,100              | 0.02                      | 0.03                       |
| 2012-030      |                          | 3                     | 30,000  | 2,750              | 0.05                      | 0.05                       | 29,000                               | 2,350              | 0.035                     | 0.035                      | 28,000                                       | 2,000              | 0.02                      | 0.025                      |
| 2012-060      |                          | 6                     | 23,500  | 2,000              | 0.03                      | 0.03                       | 23,500                               | 1,650              | 0.025                     | 0.025                      | 23,500                                       | 1,300              | 0.02                      | 0.02                       |
| 2015-030      | R0.75                    | 3                     | 30,000  | 3,000              | 0.07                      | 0.07                       | 28,500                               | 2,550              | 0.045                     | 0.05                       | 27,000                                       | 2,100              | 0.02                      | 0.03                       |
| 2015-040      |                          | 4                     | 28,500  | 2,750              | 0.06                      | 0.06                       | 27,250                               | 2,300              | 0.04                      | 0.04                       | 26,000                                       | 1,900              | 0.02                      | 0.025                      |
| 2015-060      |                          | 6                     | 26,000  | 2,200              | 0.04                      | 0.045                      | 25,500                               | 1,900              | 0.03                      | 0.03                       | 25,000                                       | 1,650              | 0.02                      | 0.02                       |
| 2015-080      |                          | 8                     | 24,000  | 2,000              | 0.025                     | 0.03                       | 24,000                               | 1,700              | 0.02                      | 0.025                      | 24,000                                       | 1,400              | 0.015                     | 0.02                       |
| 2015-100      |                          | 10                    | 16,000  | 1,300              | 0.02                      | 0.02                       | 16,000                               | 1,100              | 0.015                     | 0.018                      | 16,000                                       | 900                | 0.01                      | 0.015                      |
| 2015-120      |                          | 12                    | 12,000  | 1,000              | 0.016                     | 0.018                      | 12,000                               | 880                | 0.012                     | 0.016                      | 12,000                                       | 730                | 0.008                     | 0.012                      |
| 2015-150      |                          | 15                    | 6,000   | 600                | 0.01                      | 0.015                      | 6,000                                | 550                | 0.008                     | 0.012                      | 6,000  | 490                | 0.005                     | 0.008                      |
| 2020-040      | R1                       | 4                     | 30,000  | 3,000              | 0.1                       | 0.1                        | 27,000                               | 2,550              | 0.06                      | 0.065                      | 24,000                                       | 2,100              | 0.02                      | 0.03                       |
| 2020-050      |                          | 5                     | 28,000  | 2,750              | 0.08                      | 0.08                       | 26,000                               | 2,300              | 0.05                      | 0.05                       | 24,000                                       | 1,900              | 0.02                      | 0.025                      |
| 2020-060      |                          | 6                     | 27,000  | 2,500              | 0.05                      | 0.06                       | 25,500                               | 2,050              | 0.035                     | 0.04                       | 24,000                                       | 1,650              | 0.015                     | 0.025                      |
| 2020-080      |                          | 8                     | 25,000  | 2,200              | 0.035                     | 0.045                      | 24,500                               | 1,800              | 0.025                     | 0.03                       | 24,000                                       | 1,400              | 0.015                     | 0.02                       |
| 2020-100      |                          | 10                    | 24,000  | 2,000              | 0.02                      | 0.03                       | 24,000                               | 1,600              | 0.015                     | 0.025                      | 24,000                                       | 1,200              | 0.01                      | 0.02                       |
| 2020-120      |                          | 12                    | 19,500  | 1,600              | 0.017                     | 0.025                      | 19,500                               | 1,300              | 0.013                     | 0.021                      | 19,500                                       | 1,000              | 0.009                     | 0.017                      |
| 2020-140      |                          | 14                    | 15,000  | 1,250              | 0.015                     | 0.02                       | 15,000                               | 1,050              | 0.012                     | 0.018                      | 15,000                                       | 850                | 0.008                     | 0.015                      |
| 2020-160      |                          | 16                    | 11,500  | 990                | 0.013                     | 0.017                      | 11,500                               | 860                | 0.011                     | 0.015                      | 11,500                                       | 730                | 0.007                     | 0.013                      |
| 2020-180      |                          | 18                    | 8,000   | 740                | 0.012                     | 0.013                      | 8,000                                | 670                | 0.009                     | 0.013                      | 8,000  | 610                | 0.006                     | 0.012                      |
| 2020-200      |                          | 20                    | 4,500   | 490                | 0.01                      | 0.01                       | 4,500                                | 490                | 0.008                     | 0.01                       | 4,500  | 490                | 0.005                     | 0.01                       |
| 2030-040      | R1.5                     | 4                     | 20,000  | 2,500              | 0.1                       | 0.15                       | 18,000                               | 2,200              | 0.06                      | 0.09                       | 16,000                                       | 1,900              | 0.04                      | 0.06                       |
| 2030-060      |                          | 6                     | 20,000  | 2,500              | 0.1                       | 0.15                       | 18,000                               | 2,200              | 0.06                      | 0.09                       | 16,000                                       | 1,900              | 0.04                      | 0.06                       |
| 2030-080      |                          | 8                     | 18,000  | 2,200              | 0.08                      | 0.12                       | 17,000                               | 2,000              | 0.05                      | 0.075                      | 16,000                                       | 1,650              | 0.04                      | 0.05                       |
| 2040-060      | R2                       | 6                     | 17,000  | 2,500              | 0.12                      | 0.18                       | 15,000                               | 2,200              | 0.08                      | 0.12                       | 13,000                                       | 1,900              | 0.05                      | 0.08                       |
| 2040-080      |                          | 8                     | 17,000  | 2,500              | 0.12                      | 0.18                       | 15,000                               | 2,200              | 0.08                      | 0.12                       | 13,000                                       | 1,900              | 0.05                      | 0.08                       |
| 2040-100      |                          | 10                    | 16,000  | 2,200              | 0.1                       | 0.15                       | 14,000                               | 2,000              | 0.06                      | 0.09                       | 13,000                                       | 1,650              | 0.05                      | 0.08                       |

## Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Recommend oil mist to avoid tool damage.



Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data





Size  $\phi 0.2 \sim \phi 2$

# CBN-RSF



Patented in Japan, Taiwan

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

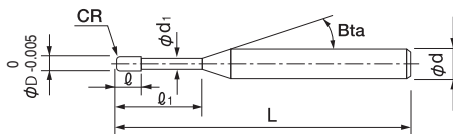
| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        | ●      | ●      |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |

Label Sample

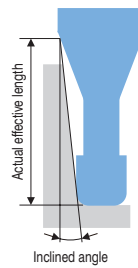


#001  $\phi D0.998$  R+0.001/0.000

Diameter and Corner R accuracy measurements are printed on the label to support High Precision milling.

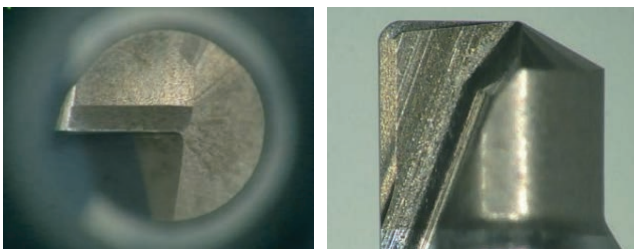


The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

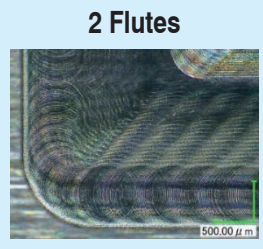
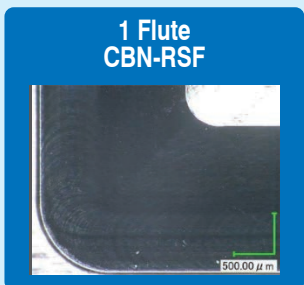


## Features

The tool relief rubs against the milling surface to create a burnished finish. 1 flute design enables an even milling amount and prevents chip biting caused by runout.



**The cutting edge at the tip point has a burnishing effect. (ELMAX 60HRC)**  
The unique design on the tool relief offers a shiny surface finish.



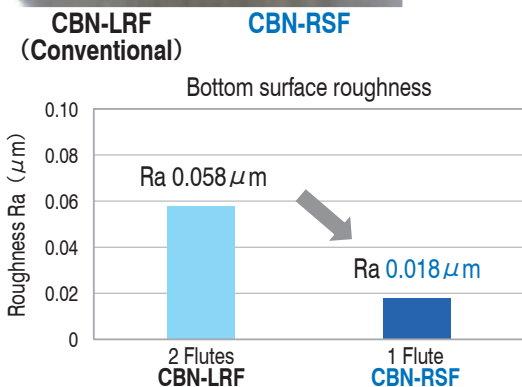
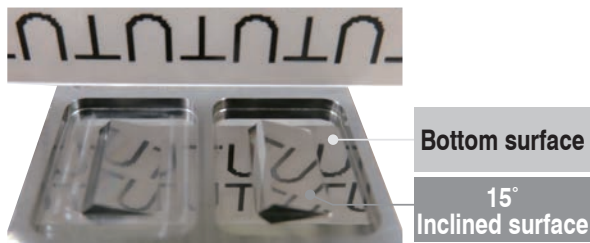
- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



## Inclined pocket milling

1 Flute CBN-RSF  $\phi 2 \times CR0.1 \times EL4$

ELMAX (60HRC)



|                                 |                          |
|---------------------------------|--------------------------|
| Process                         | Finishing                |
| Milling Method                  | Contour Milling          |
| Spindle Speed                   | 30,000 $\text{min}^{-1}$ |
| Feed Rate                       | 375 mm/min               |
| Finishing Allowance             | 0.01 mm/min              |
| Cusp Height at Inclined Surface | 0.00003 mm               |
| Cycle Time                      | 61 min                   |

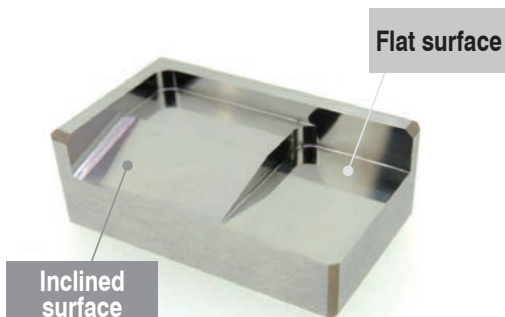
**Improved quality for milling on the bottom, inclined and vertical surfaces as compared to conventional CBN-LRF series.**

Milled Size :  $9 \times 13 \times \text{Depth } 1 \text{ mm}$   
Coolant : Oil Mist

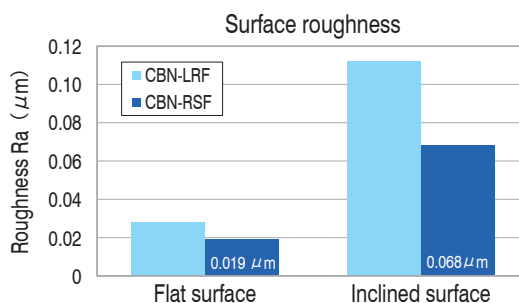
## Pocket milling

1 Flute CBN-RSF  $\phi 2 \times CR0.1 \times EL4$

ELMAX (60HRC)



Work Size :  $25 \times 25 \times 10 \text{ mm}$   
Coolant : Oil Mist



**1 flute CBN-RSF gives excellent surface roughness**

| No. | Process        | Tool                                     | Spindle Speed ( $\text{min}^{-1}$ ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Allowance (mm) | Cycle Time (h:m:s) |
|-----|----------------|--|-------------------------------------|--------------------|------------|------------|----------------|--------------------|
| 1   | Roughing       | HGLB R1 $\times$ EL4                     | 14,000                              | 2,100              | 0.15       | 0.5        | 0.05           | 0:10:17            |
| 2   | Semi-finishing | HLRS $\phi 2 \times CR0.1 \times EL4$    | 11,500                              | 860                | 0.031      | 0.36       | 0.05           | 1:11:50            |
|     |                |  |                                     |                    | 0.02       | 0.36       | 0.02           |                    |
|     |                |  |                                     |                    | 0.005      | 0.1        | 0.01           |                    |
| 3   | Finishing      | CBN-RSF $\phi 2 \times CR0.1 \times EL4$ | 30,000                              | 375                | 0.01       | 0.1        | 0              | 2:25:01            |

Total 3:47:08

$\phi 3 \text{mm}$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

# 1 Flute CBN Long Neck Radius End Mills for Super Finishing

Total 42 models

\*Shank taper angle Bta is only for reference.

Unit (mm)

| Model Number        | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |      |       |      |      |
|---------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|------|-------|------|------|
|                     |                           |                  |                           |                      |                          |                       |                  |                         |                          | 30°                                 | 1°   | 1°30' | 2°   | 3°   |
| CBN-RSF 1002-002003 | 0.2                       | RO.02            | 0.3                       | 0.08                 | 0.19                     | 15°                   | 50               | 4                       | 36,600                   | 0.30                                | 0.30 | 0.30  | 0.31 | 0.34 |
| CBN-RSF 1002-002005 |                           |                  | 0.5                       |                      |                          |                       | 50               | 4                       | 36,600                   | 0.50                                | 0.50 | 0.52  | 0.54 | 0.59 |
| CBN-RSF 1002-005003 |                           | RO.05            | 0.3                       |                      |                          |                       | 50               | 4                       | 32,900                   | 0.30                                | 0.30 | 0.30  | 0.31 | 0.33 |
| CBN-RSF 1002-005005 |                           |                  | 0.5                       |                      |                          |                       | 50               | 4                       | 32,900                   | 0.50                                | 0.50 | 0.52  | 0.54 | 0.58 |
| CBN-RSF 1003-002005 | 0.3                       | RO.02            | 0.5                       | 0.13                 | 0.28                     | 15°                   | 50               | 4                       | 36,200                   | 0.51                                | 0.53 | 0.55  | 0.57 | 0.62 |
| CBN-RSF 1003-002010 |                           |                  | 1                         |                      |                          |                       | 50               | 4                       | 36,600                   | 1.03                                | 1.07 | 1.11  | 1.15 | 1.25 |
| CBN-RSF 1003-005005 |                           | RO.05            | 0.5                       |                      |                          |                       | 50               | 4                       | 32,500                   | 0.51                                | 0.53 | 0.55  | 0.57 | 0.62 |
| CBN-RSF 1003-005010 |                           |                  | 1                         |                      |                          |                       | 50               | 4                       | 32,900                   | 1.03                                | 1.07 | 1.10  | 1.15 | 1.24 |
| CBN-RSF 1004-002005 | 0.4                       | RO.02            | 0.5                       | 0.24                 | 0.38                     | 15°                   | 50               | 4                       | 34,300                   | 0.51                                | 0.53 | 0.55  | 0.57 | 0.62 |
| CBN-RSF 1004-002015 |                           |                  | 1.5                       |                      |                          |                       | 50               | 4                       | 35,000                   | 1.54                                | 1.59 | 1.65  | 1.71 | 1.86 |
| CBN-RSF 1004-005005 |                           | RO.05            | 0.5                       |                      |                          |                       | 50               | 4                       | 30,900                   | 0.51                                | 0.53 | 0.55  | 0.57 | 0.62 |
| CBN-RSF 1004-005015 |                           |                  | 1.5                       |                      |                          |                       | 50               | 4                       | 31,100                   | 1.54                                | 1.59 | 1.65  | 1.71 | 1.85 |
| CBN-RSF 1005-002005 | 0.5                       | RO.02            | 0.5                       | 0.3                  | 0.48                     | 15°                   | 50               | 4                       | 28,200                   | 0.51                                | 0.53 | 0.55  | 0.57 | 0.62 |
| CBN-RSF 1005-002015 |                           |                  | 1.5                       |                      |                          |                       | 50               | 4                       | 28,700                   | 1.54                                | 1.59 | 1.65  | 1.71 | 1.86 |
| CBN-RSF 1005-005005 |                           | RO.05            | 0.5                       |                      |                          |                       | 50               | 4                       | 25,400                   | 0.51                                | 0.53 | 0.55  | 0.57 | 0.62 |
| CBN-RSF 1005-005015 |                           |                  | 1.5                       |                      |                          |                       | 50               | 4                       | 25,800                   | 1.54                                | 1.59 | 1.65  | 1.71 | 1.85 |
| CBN-RSF 1006-002010 | 0.6                       | RO.02            | 1                         | 0.3                  | 0.58                     | 15°                   | 50               | 4                       | 28,500                   | 1.03                                | 1.07 | 1.11  | 1.15 | 1.25 |
| CBN-RSF 1006-002015 |                           |                  | 1.5                       |                      |                          |                       | 50               | 4                       | 28,700                   | 1.54                                | 1.59 | 1.65  | 1.71 | 1.86 |
| CBN-RSF 1006-005010 |                           | RO.05            | 1                         |                      |                          |                       | 50               | 4                       | 25,600                   | 1.03                                | 1.07 | 1.10  | 1.15 | 1.24 |
| CBN-RSF 1006-005015 |                           |                  | 1.5                       |                      |                          |                       | 50               | 4                       | 25,800                   | 1.54                                | 1.59 | 1.65  | 1.71 | 1.85 |
| CBN-RSF 1008-002010 | 0.8                       | RO.02            | 1                         | 0.56                 | 0.78                     | 15°                   | 50               | 4                       | 28,700                   | 1.03                                | 1.07 | 1.11  | 1.15 | 1.25 |
| CBN-RSF 1008-002020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 28,700                   | 2.05                                | 2.13 | 2.20  | 2.29 | 2.48 |
| CBN-RSF 1008-005010 |                           | RO.05            | 1                         |                      |                          |                       | 50               | 4                       | 25,800                   | 1.03                                | 1.07 | 1.10  | 1.15 | 1.24 |
| CBN-RSF 1008-005020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 25,800                   | 2.05                                | 2.12 | 2.20  | 2.28 | 2.47 |
| CBN-RSF 1010-002010 | 1                         | RO.02            | 1                         | 0.7                  | 0.98                     | 15°                   | 50               | 4                       | 26,400                   | 1.03                                | 1.07 | 1.11  | 1.15 | 1.25 |
| CBN-RSF 1010-002020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 26,400                   | 2.07                                | 2.14 | 2.22  | 2.30 | 2.49 |
| CBN-RSF 1010-002030 |                           |                  | 3                         |                      |                          |                       | 50               | 4                       | 26,400                   | 3.10                                | 3.21 | 3.33  | 3.45 | 3.73 |
| CBN-RSF 1010-005010 |                           |                  | 1                         |                      |                          |                       | 50               | 4                       | 23,700                   | 1.03                                | 1.07 | 1.11  | 1.15 | 1.24 |
| CBN-RSF 1010-005020 |                           | RO.05            | 2                         |                      |                          |                       | 50               | 4                       | 23,700                   | 2.06                                | 2.14 | 2.21  | 2.30 | 2.48 |
| CBN-RSF 1010-005030 |                           |                  | 3                         |                      |                          |                       | 50               | 4                       | 23,700                   | 3.10                                | 3.21 | 3.32  | 3.45 | 3.73 |
| CBN-RSF 1010-010010 |                           | RO.1             | 1                         |                      |                          |                       | 50               | 4                       | 23,700                   | 1.03                                | 1.06 | 1.10  | 1.14 | 1.23 |
| CBN-RSF 1010-010020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 23,700                   | 2.06                                | 2.13 | 2.21  | 2.29 | 2.47 |
| CBN-RSF 1010-010030 | 3                         |                  | 50                        | 4                    | 23,700                   | 3.10                  | 3.20             | 3.32                    | 3.44                     | 3.72                                |      |       |      |      |
| CBN-RSF 1015-002030 | 1.5                       |                  | RO.02                     | 3                    | 1                        | 1.46                  | 15°              | 50                      | 4                        | 31,000                              | 3.14 | 3.25  | 3.37 | 3.49 |
| CBN-RSF 1015-005030 |                           | RO.05            | 3                         | 50                   |                          |                       |                  | 4                       | 27,900                   | 3.14                                | 3.25 | 3.36  | 3.49 | 3.77 |
| CBN-RSF 1015-010030 |                           | RO.1             | 3                         | 50                   |                          |                       |                  | 4                       | 27,900                   | 3.14                                | 3.24 | 3.36  | 3.48 | 3.76 |
| CBN-RSF 1020-002040 | 2                         | RO.02            | 4                         | 1.2                  | 1.97                     | 15°                   | 50               | 4                       | 32,000                   | 4.15                                | 4.30 | 4.45  | 4.62 | 5.00 |
| CBN-RSF 1020-002060 |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 32,000                   | 6.22                                | 6.44 | 6.67  | 6.92 | 7.49 |
| CBN-RSF 1020-005040 |                           | RO.05            | 4                         |                      |                          |                       | 50               | 4                       | 28,700                   | 4.15                                | 4.30 | 4.45  | 4.62 | 4.99 |
| CBN-RSF 1020-005060 |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 28,700                   | 6.22                                | 6.44 | 6.67  | 6.92 | 7.48 |
| CBN-RSF 1020-010040 |                           | RO.1             | 4                         |                      |                          |                       | 50               | 4                       | 28,700                   | 4.15                                | 4.29 | 4.45  | 4.61 | 4.98 |
| CBN-RSF 1020-010060 |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 28,700                   | 6.22                                | 6.43 | 6.66  | 6.91 | 7.47 |

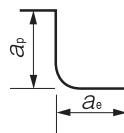
- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for CBN-RSF

| WORK MATERIAL |                       |                    |                       | HARDENED STEELS<br>ELMAX<br>(58~62HRC) |                    |                           |                            | HARDENED STEELS<br>HAP10<br>(62~65HRC) |                    |                           |                            |
|---------------|-----------------------|--------------------|-----------------------|--|--------------------|---------------------------|----------------------------|--|--------------------|---------------------------|----------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 1002-002003   | 0.2                   | R0.02              | 0.3                   | 60,000                                 | 80 MAX             | 0.003                     | 0.01                       | 60,000                                 | 20 MAX             | 0.003                     | 0.005                      |
| 1002-002005   |                       |                    | 0.5                   | 60,000                                 | 80 MAX             | 0.003                     | 0.01                       | 60,000                                 | 20 MAX             | 0.003                     | 0.005                      |
| 1002-005003   |                       | R0.05              | 0.3                   | 60,000                                 | 80 MAX             | 0.003                     | 0.01                       | 60,000                                 | 20 MAX             | 0.003                     | 0.005                      |
| 1002-005005   |                       |                    | 0.5                   | 60,000                                 | 80 MAX             | 0.003                     | 0.01                       | 60,000                                 | 20 MAX             | 0.003                     | 0.005                      |
| 1003-002005   | 0.3                   | R0.02              | 0.5                   | 40,000                                 | 80 MAX             | 0.004                     | 0.015                      | 40,000                                 | 20 MAX             | 0.004                     | 0.005                      |
| 1003-002010   |                       |                    | 1                     | 40,000                                 | 80 MAX             | 0.004                     | 0.015                      | 40,000                                 | 20 MAX             | 0.004                     | 0.005                      |
| 1003-005005   |                       | R0.05              | 0.5                   | 40,000                                 | 80 MAX             | 0.004                     | 0.015                      | 40,000                                 | 20 MAX             | 0.004                     | 0.005                      |
| 1003-005010   |                       |                    | 1                     | 40,000                                 | 80 MAX             | 0.004                     | 0.015                      | 40,000                                 | 20 MAX             | 0.004                     | 0.005                      |
| 1004-002005   | 0.4                   | R0.02              | 0.5                   | 30,000                                 | 80 MAX             | 0.005                     | 0.02                       | 30,000                                 | 20 MAX             | 0.005                     | 0.006                      |
| 1004-002015   |                       |                    | 1.5                   | 30,000                                 | 80 MAX             | 0.005                     | 0.02                       | 30,000                                 | 20 MAX             | 0.005                     | 0.006                      |
| 1004-005005   |                       | R0.05              | 0.5                   | 30,000                                 | 100 MAX            | 0.005                     | 0.02                       | 30,000                                 | 60 MAX             | 0.005                     | 0.02                       |
| 1004-005015   |                       |                    | 1.5                   | 30,000                                 | 100 MAX            | 0.005                     | 0.02                       | 30,000                                 | 60 MAX             | 0.005                     | 0.02                       |
| 1005-002005   | 0.5                   | R0.02              | 0.5                   | 30,000                                 | 90 MAX             | 0.005                     | 0.025                      | 30,000                                 | 25 MAX             | 0.005                     | 0.008                      |
| 1005-002015   |                       |                    | 1.5                   | 30,000                                 | 90 MAX             | 0.005                     | 0.025                      | 30,000                                 | 25 MAX             | 0.005                     | 0.008                      |
| 1005-005005   |                       | R0.05              | 0.5                   | 30,000                                 | 100 MAX            | 0.01                      | 0.025                      | 30,000                                 | 60 MAX             | 0.01                      | 0.025                      |
| 1005-005015   |                       |                    | 1.5                   | 30,000                                 | 100 MAX            | 0.01                      | 0.025                      | 30,000                                 | 60 MAX             | 0.01                      | 0.025                      |
| 1006-002010   | 0.6                   | R0.02              | 1                     | 30,000                                 | 100 MAX            | 0.005                     | 0.03                       | 30,000                                 | 30 MAX             | 0.005                     | 0.01                       |
| 1006-002015   |                       |                    | 1.5                   | 30,000                                 | 100 MAX            | 0.005                     | 0.03                       | 30,000                                 | 30 MAX             | 0.005                     | 0.01                       |
| 1006-005010   |                       | R0.05              | 1                     | 30,000                                 | 110 MAX            | 0.01                      | 0.03                       | 30,000                                 | 65 MAX             | 0.01                      | 0.03                       |
| 1006-005015   |                       |                    | 1.5                   | 30,000                                 | 110 MAX            | 0.01                      | 0.03                       | 30,000                                 | 65 MAX             | 0.01                      | 0.03                       |
| 1008-002010   | 0.8                   | R0.02              | 1                     | 30,000                                 | 125 MAX            | 0.005                     | 0.04                       | 30,000                                 | 40 MAX             | 0.005                     | 0.012                      |
| 1008-002020   |                       |                    | 2                     | 30,000                                 | 125 MAX            | 0.005                     | 0.04                       | 30,000                                 | 40 MAX             | 0.005                     | 0.012                      |
| 1008-005010   |                       | R0.05              | 1                     | 30,000                                 | 140 MAX            | 0.01                      | 0.04                       | 30,000                                 | 85 MAX             | 0.01                      | 0.04                       |
| 1008-005020   |                       |                    | 2                     | 30,000                                 | 140 MAX            | 0.01                      | 0.04                       | 30,000                                 | 85 MAX             | 0.01                      | 0.04                       |
| 1010-002010   | 1                     | R0.02              | 1                     | 30,000                                 | 150 MAX            | 0.005                     | 0.05                       | 30,000                                 | 50 MAX             | 0.005                     | 0.015                      |
| 1010-002020   |                       |                    | 2                     | 30,000                                 | 150 MAX            | 0.005                     | 0.05                       | 30,000                                 | 50 MAX             | 0.005                     | 0.015                      |
| 1010-002030   |                       |                    | 3                     | 30,000                                 | 150 MAX            | 0.005                     | 0.05                       | 30,000                                 | 50 MAX             | 0.005                     | 0.015                      |
| 1010-005010   |                       | R0.05              | 1                     | 30,000                                 | 165 MAX            | 0.01                      | 0.05                       | 30,000                                 | 100 MAX            | 0.01                      | 0.04                       |
| 1010-005020   |                       |                    | 2                     | 30,000                                 | 165 MAX            | 0.01                      | 0.05                       | 30,000                                 | 100 MAX            | 0.01                      | 0.04                       |
| 1010-005030   |                       |                    | 3                     | 30,000                                 | 165 MAX            | 0.01                      | 0.05                       | 30,000                                 | 100 MAX            | 0.01                      | 0.04                       |
| 1010-010010   |                       | R0.1               | 1                     | 30,000                                 | 185 MAX            | 0.01                      | 0.05                       | 30,000                                 | 150 MAX            | 0.01                      | 0.05                       |
| 1010-010020   |                       |                    | 2                     | 30,000                                 | 185 MAX            | 0.01                      | 0.05                       | 30,000                                 | 150 MAX            | 0.01                      | 0.05                       |
| 1010-010030   |                       |                    | 3                     | 30,000                                 | 185 MAX            | 0.01                      | 0.05                       | 30,000                                 | 150 MAX            | 0.01                      | 0.05                       |
| 1015-002030   |                       | 1.5                | R0.02                 | 3                                      | 30,000             | 225 MAX                   | 0.005                      | 0.075                                  | 30,000             | 75 MAX                    | 0.005                      |
| 1015-005030   | R0.05                 |                    | 3                     | 30,000                                 | 250 MAX            | 0.01                      | 0.075                      | 30,000                                 | 150 MAX            | 0.01                      | 0.05                       |
| 1015-010030   | R0.1                  |                    | 3                     | 30,000                                 | 280 MAX            | 0.01                      | 0.075                      | 30,000                                 | 225 MAX            | 0.01                      | 0.075                      |
| 1020-002040   | 2                     | R0.02              | 4                     | 30,000                                 | 300 MAX            | 0.005                     | 0.1                        | 30,000                                 | 100 MAX            | 0.005                     | 0.03                       |
| 1020-002060   |                       |                    | 6                     | 30,000                                 | 300 MAX            | 0.005                     | 0.1                        | 30,000                                 | 100 MAX            | 0.005                     | 0.03                       |
| 1020-005040   |                       | R0.05              | 4                     | 30,000                                 | 330 MAX            | 0.01                      | 0.1                        | 30,000                                 | 200 MAX            | 0.01                      | 0.07                       |
| 1020-005060   |                       |                    | 6                     | 30,000                                 | 330 MAX            | 0.01                      | 0.1                        | 30,000                                 | 200 MAX            | 0.01                      | 0.07                       |
| 1020-010040   |                       | R0.1               | 4                     | 30,000                                 | 375 MAX            | 0.01                      | 0.1                        | 30,000                                 | 300 MAX            | 0.01                      | 0.1                        |
| 1020-010060   |                       |                    | 6                     | 30,000                                 | 375 MAX            | 0.01                      | 0.1                        | 30,000                                 | 300 MAX            | 0.01                      | 0.1                        |

## Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Recommend oil mist to avoid tool damage.

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.1 \sim \phi 3$

# CBN-LRF2000

Additional 4 models

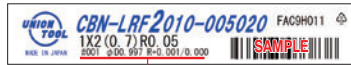
CBN
 $0^\circ$ 
R
 $\pm 0.002$ 
 $\pm 0.003$ 
Shank Dia.  $0/-0.004$ 
Back Taper Geometry

CR $\leq 0.03$  CR $\cong 0.05$

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

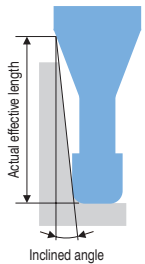
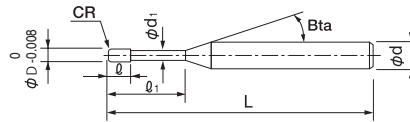
| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 | ○                                | ●               | ●      | ●      | ●      | ●      |           |                 |          |        |          |                       |                 |                       |                  |                                       |

Label Sample



#001  $\phi D0.997$  R+0.001/0.000

Diameter and Corner R accuracy measurements are printed on the label to support High Precision milling.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

## Features

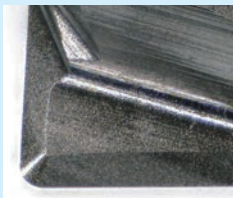
Various lineup from  $\phi 0.1$  to  $\phi 3$



## CBN-LRF2000/4000 Common features

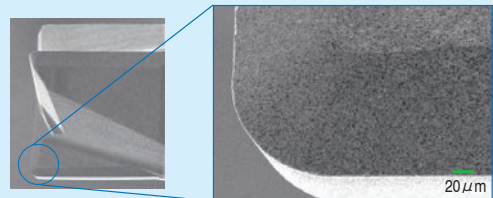
### Feature 1 High rigidity cutting edge

Super negative rake angle from the cutting edge at the tip point to peripheral cutting edge. Less damage when milling hard materials.



### Feature 2 Sharp cutting edge

The cutting edge is outstandingly sharp even with the super negative rake angle.



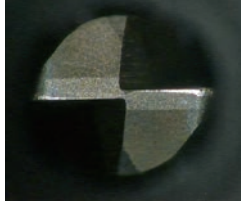
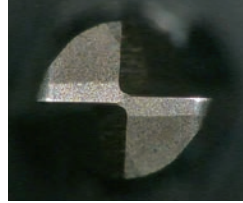
## Fuel cell separator mold

### 2 Flutes CBN-LRF $\phi 1 \times CR0.1 \times EL1$

SKH51 (63HRC)



Size : 80 × 80 × 40 mm

After finishing of crank shape  
(Milling time 10h 23min)After finishing of wave shape  
(Milling time 2h 58min)

## CBN-LRF 2000

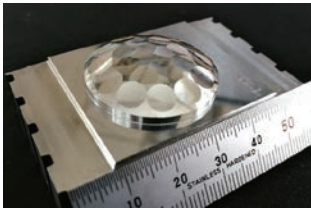


| Process        | Tool   | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Allowance (mm) | $a_p$ (mm) | $a_e$ (mm) | Coolant  | Cycle Time (h:m:s) |
|----------------|--|------------------------------------|--------------------|----------------|------------|------------|----------|--------------------|
| Roughing       | HLRS $\phi 1 \times CR0.3 \times EL2$                      | 10,900                             | 710                | —              | 0.03       | 0.27       | Air Blow | 2:43:45            |
| Semi-finishing | HLRS $\phi 1 \times CR0.2 \times EL2$                      | 10,900                             | 710                | 0.015          | 0.03       | 0.1        |          | 3:07:09            |
| Finishing      | <b>CBN-LRF <math>\phi 1 \times CR0.1 \times EL1</math></b> | 30,000                             | 525                | 0.005          | 0.01       | 0.1        | Oil Mist | 13:21:57           |
| Total          |  |                                    |                    |                |            |            |          | 19:12:51           |

## CBN bottom surface finishing

### 2 Flutes CBN-LRF $\phi 2 \times CR0.1 \times EL1$

STAVAX (52HRC)



Size : 60 × 35 × 20 mm

Surface roughness Ra 0.03  $\mu$ mBottom  
surface  
milling

## CBN-LRF 2000



| Process        | Tool   | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Cycle Time (h:m:s) |
|----------------|--|------------------------------------|--------------------|------------|------------|--------------------|
| Roughing       | HRRS $\phi 6 \times CR1$                                   | 6,000                              | 4,000              | 0.3        | 2.7        | 0:03:00            |
| Semi-finishing | HRRS $\phi 6 \times CR1$                                   | 15,000                             | 7,000              | 0.03       | 0.03       | 0:04:00            |
| Semi-finishing | HSB R1.5   | 30,000                             | 1,200              | 0.05       | 0.05       | 0:13:00            |
| Semi-finishing | HSB R1   | 30,000                             | 1,000              | 0.01       | 0.01       | 1:20:00            |
| Finishing      | CBN-LBSF R1  | 30,000                             | 1,000              | 0.003      | 0.003      | 4:30:00            |
| Semi-finishing | HLRS $\phi 2 \times CR0.1 \times EL4$                      | 20,000                             | 2,000              | 0.04       | 0.2        | 0:05:00            |
| Semi-finishing | <b>CBN-LRF <math>\phi 2 \times CR0.1 \times EL4</math></b> | 20,000                             | 1,200              | 0.02       | 0.15       | 0:13:00            |
| Finishing      | <b>CBN-LRF <math>\phi 2 \times CR0.1 \times EL4</math></b> | 25,000                             | 1,000              | 0.01       | 0.1        | 0:38:00            |
| Finishing      | HSB R0.1   | 10,000                             | 50                 | 0.01       | —          | 0:07:00            |
| Total          |  |                                    |                    |            |            | 7:13:00            |

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

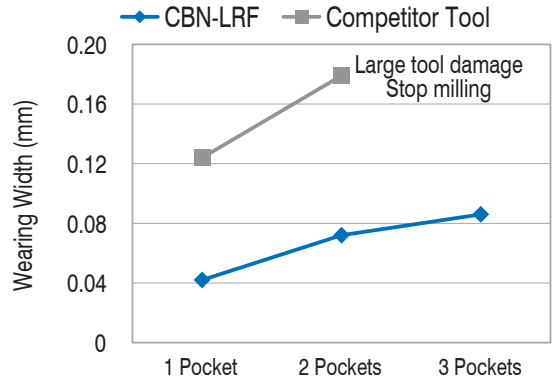
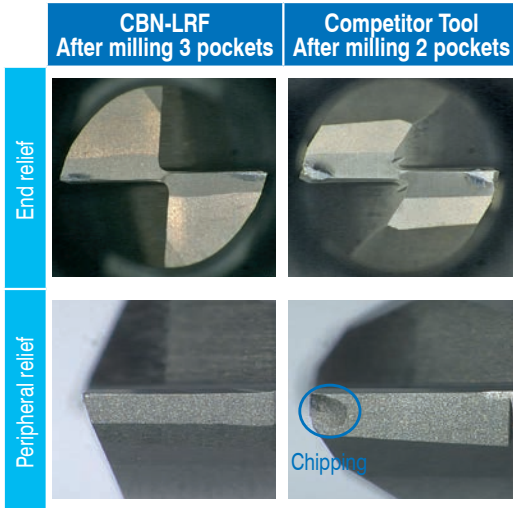
Spiral  
V Cutter

Drill

Technical Data

**Pocket milling**  
**2 Flutes CBN-LRF  $\phi 2 \times CR0.02 \times EL4$**

HAP10 (65HRC)



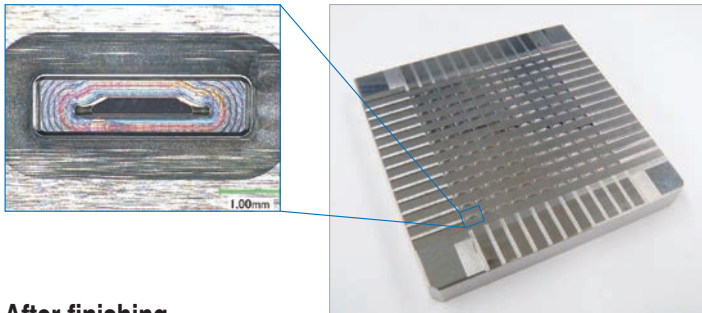
**Less tool damage on 65HRC high speed steel!**

Pocket Size :  $15 \times 15 \times 0.3$  mm  
 Coolant : Oil Mist

| Tool                                      | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Cycle Time      |
|---|------------------------------------|--------------------|------------|------------|-----------------|
| CBN-LRF $\phi 2 \times CR0.02 \times EL4$ | 16,000                             | 530                | 0.005      | 0.4        | 59 min / pocket |

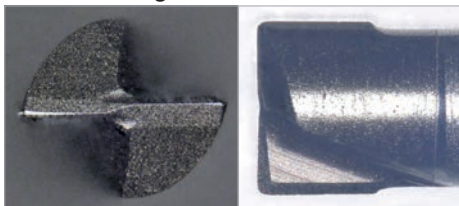
**LED mold**  
**2 Flutes CBN-LRF  $\phi 0.4 \times CR0.02 \times EL1$**

ELMAX (62HRC)



Work Size :  $80 \times 80 \times 10$  mm  
 Coolant : Oil Mist

**After finishing**



**Less tool damage after 10 hours' milling!**

| Tool  | Process   | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Cycle Time |
|---|-----------|------------------------------------|--------------------|------------|------------|------------|
| CBN-LRF $\phi 0.4 \times CR0.02 \times EL1$ | Finishing | 38,000                             | 600                | 0.01       | 0.01       | 10 h       |



Total 143 models

\*Shank taper angle Bta is only for reference.

Unit (mm)

| Model Number         | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |      |       |      |      |
|----------------------|---------------------------|------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|------|-------|------|------|
|                      |                           |                  |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°   | 1°30' | 2°   | 3°   |
| CBN-LRF 2001-002002  | 0.1                       | RO.02            | 0.2                    | 0.04              | 0.09                     | 15°                   | 50               | 4                       | 44,500                   | 0.20                                | 0.20 | 0.20  | 0.20 | 0.21 |
| CBN-LRF 2001-002003  |                           |                  | 0.3                    |                   |                          |                       | 50               | 4                       | 45,200                   | 0.30                                | 0.30 | 0.30  | 0.30 | 0.33 |
| CBN-LRF 2001-002005  |                           |                  | 0.5                    |                   |                          |                       | 50               | 4                       | 46,500                   | 0.50                                | 0.50 | 0.51  | 0.53 | 0.58 |
| CBN-LRF 2001-003002  |                           | RO.03            | 0.2                    |                   |                          |                       | 50               | 4                       | 42,500                   | 0.20                                | 0.20 | 0.20  | 0.20 | 0.21 |
| CBN-LRF 2001-003003  |                           |                  | 0.3                    |                   |                          |                       | 50               | 4                       | 43,200                   | 0.30                                | 0.30 | 0.30  | 0.30 | 0.33 |
| CBN-LRF 2001-003005  |                           |                  | 0.5                    |                   |                          |                       | 50               | 4                       | 44,500                   | 0.50                                | 0.50 | 0.51  | 0.53 | 0.58 |
| CBN-LRF 20015-002X2  | 0.15                      | RO.02            | 0.2                    | 0.06              | 0.14                     | 15°                   | 50               | 4                       | 44,500                   | 0.20                                | 0.20 | 0.20  | 0.20 | 0.21 |
| CBN-LRF 20015-002X3  |                           |                  | 0.3                    |                   |                          |                       | 50               | 4                       | 45,200                   | 0.30                                | 0.30 | 0.30  | 0.30 | 0.33 |
| CBN-LRF 20015-002X5  |                           |                  | 0.5                    |                   |                          |                       | 50               | 4                       | 46,500                   | 0.50                                | 0.50 | 0.51  | 0.53 | 0.58 |
| CBN-LRF 20015-003X2  |                           | RO.03            | 0.2                    |                   |                          |                       | 50               | 4                       | 42,500                   | 0.20                                | 0.20 | 0.20  | 0.20 | 0.21 |
| CBN-LRF 20015-003X3  |                           |                  | 0.3                    |                   |                          |                       | 50               | 4                       | 43,200                   | 0.30                                | 0.30 | 0.30  | 0.30 | 0.33 |
| CBN-LRF 20015-003X5  |                           |                  | 0.5                    |                   |                          |                       | 50               | 4                       | 44,500                   | 0.50                                | 0.50 | 0.51  | 0.53 | 0.58 |
| CBN-LRF 2002-002005  | 0.2                       | RO.02            | 0.5                    | 0.08              | 0.19                     | 15°                   | 50               | 4                       | 33,900                   | 0.50                                | 0.50 | 0.51  | 0.53 | 0.58 |
| CBN-LRF 2002-002X75  |                           |                  | 0.75                   |                   |                          |                       | 50               | 4                       | 34,400                   | 0.75                                | 0.76 | 0.79  | 0.82 | 0.89 |
| CBN-LRF 2002-002010  |                           |                  | 1                      |                   |                          |                       | 50               | 4                       | 34,900                   | 1.00                                | 1.03 | 1.07  | 1.11 | 1.20 |
| CBN-LRF 2002-003005  |                           | RO.03            | 0.5                    |                   |                          |                       | 50               | 4                       | 30,500                   | 0.50                                | 0.50 | 0.51  | 0.53 | 0.58 |
| CBN-LRF 2002-003X75  |                           |                  | 0.75                   |                   |                          |                       | 50               | 4                       | 30,900                   | 0.75                                | 0.76 | 0.79  | 0.82 | 0.89 |
| CBN-LRF 2002-003010  |                           |                  | 1                      |                   |                          |                       | 50               | 4                       | 31,400                   | 1.00                                | 1.03 | 1.07  | 1.11 | 1.20 |
| CBN-LRF 2002-005005  | 0.25                      | RO.05            | 0.5                    | 0.1               | 0.24                     | 15°                   | 50               | 4                       | 30,500                   | 0.50                                | 0.50 | 0.51  | 0.53 | 0.57 |
| CBN-LRF 2002-005X75  |                           |                  | 0.75                   |                   |                          |                       | 50               | 4                       | 30,900                   | 0.75                                | 0.76 | 0.79  | 0.82 | 0.88 |
| CBN-LRF 2002-005010  |                           |                  | 1                      |                   |                          |                       | 50               | 4                       | 31,400                   | 1.00                                | 1.03 | 1.06  | 1.10 | 1.19 |
| CBN-LRF 20025-005X5  |                           | RO.01            | 0.5                    |                   |                          |                       | 50               | 4                       | 33,900                   | 1.02                                | 1.06 | 1.10  | 1.14 | 1.24 |
| CBN-LRF 20025-002005 |                           |                  | 0.5                    |                   |                          |                       | 50               | 4                       | 33,500                   | 0.51                                | 0.53 | 0.55  | 0.57 | 0.62 |
| CBN-LRF 20025-002X75 |                           |                  | 0.75                   |                   |                          |                       | 50               | 4                       | 33,700                   | 0.77                                | 0.79 | 0.82  | 0.86 | 0.93 |
| CBN-LRF 2003-002010  | 0.3                       | RO.02            | 1                      | 0.13              | 0.28                     | 15°                   | 50               | 4                       | 33,900                   | 1.02                                | 1.06 | 1.10  | 1.14 | 1.24 |
| CBN-LRF 2003-002015  |                           |                  | 1.5                    |                   |                          |                       | 50               | 4                       | 34,400                   | 1.54                                | 1.60 | 1.65  | 1.72 | 1.86 |
| CBN-LRF 2003-002020  |                           |                  | 2                      |                   |                          |                       | 50               | 4                       | 34,900                   | 2.05                                | 2.12 | 2.20  | 2.28 | 2.47 |
| CBN-LRF 2003-003005  |                           | RO.03            | 0.5                    |                   |                          |                       | 50               | 4                       | 30,100                   | 0.51                                | 0.53 | 0.55  | 0.57 | 0.62 |
| CBN-LRF 2003-003X75  |                           |                  | 0.75                   |                   |                          |                       | 50               | 4                       | 30,300                   | 0.77                                | 0.79 | 0.82  | 0.85 | 0.93 |
| CBN-LRF 2003-003010  |                           |                  | 1                      |                   |                          |                       | 50               | 4                       | 30,500                   | 1.02                                | 1.06 | 1.10  | 1.14 | 1.24 |
| CBN-LRF 2003-003015  | RO.05                     | 1.5              | 50                     | 4                 | 30,900                   | 1.54                  | 1.60             | 1.65                    | 1.72                     | 1.86                                |      |       |      |      |
| CBN-LRF 2003-003020  |                           | 2                | 50                     | 4                 | 31,300                   | 2.05                  | 2.12             | 2.20                    | 2.28                     | 2.47                                |      |       |      |      |
| CBN-LRF 2003-005005  |                           | 0.5              | 50                     | 4                 | 30,100                   | 0.51                  | 0.52             | 0.54                    | 0.56                     | 0.61                                |      |       |      |      |
| CBN-LRF 2003-005X75  |                           | 0.75             | 50                     | 4                 | 30,300                   | 0.76                  | 0.79             | 0.82                    | 0.85                     | 0.92                                |      |       |      |      |
| CBN-LRF 2003-005010  |                           | 1                | 50                     | 4                 | 30,500                   | 1.02                  | 1.06             | 1.10                    | 1.14                     | 1.23                                |      |       |      |      |
| CBN-LRF 2003-005015  |                           | 1.5              | 50                     | 4                 | 30,900                   | 1.54                  | 1.59             | 1.65                    | 1.71                     | 1.85                                |      |       |      |      |
| CBN-LRF 2003-005020  | 2                         | 50               | 4                      | 31,300            | 2.05                     | 2.12                  | 2.20             | 2.28                    | 2.46                     |                                     |      |       |      |      |

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3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## 2 Flutes CBN Long Neck Radius End Mills

Unit (mm)

| Model Number        | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |        |       |        |      |      |      |      |      |
|---------------------|---------------------------|------------------|------------------------|-------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|-------------------------------------|--------|-------|--------|------|------|------|------|------|
|                     |                           |                  |                        |                   |                          |                           |                  |                         |                          | 30°                                 | 1°     | 1°30' | 2°     | 3°   |      |      |      |      |
| CBN-LRF 2004-002005 | 0.4                       | RO.02            | 0.5                    | 0.24              | 0.38                     | 15°                       | 50               | 4                       | 31,800                   | 0.51                                | 0.53   | 0.55  | 0.57   | 0.62 |      |      |      |      |
| CBN-LRF 2004-002010 |                           |                  | 1                      |                   |                          |                           | 50               | 4                       | 32,000                   | 1.02                                | 1.06   | 1.10  | 1.14   | 1.24 |      |      |      |      |
| CBN-LRF 2004-002015 |                           |                  | 1.5                    |                   |                          |                           | 50               | 4                       | 32,400                   | 1.53                                | 1.59   | 1.64  | 1.71   | 1.85 |      |      |      |      |
| CBN-LRF 2004-002020 |                           |                  | 2                      |                   |                          |                           | 50               | 4                       | 32,800                   | 2.05                                | 2.12   | 2.20  | 2.28   | 2.47 |      |      |      |      |
| CBN-LRF 2004-003005 |                           |                  | 0.5                    |                   |                          |                           | RO.03            | 1                       | 50                       | 4                                   | 28,600 | 0.51  | 0.53   | 0.55 | 0.57 | 0.62 |      |      |
| CBN-LRF 2004-003010 |                           | 1                | 50                     |                   |                          |                           |                  | 4                       | 28,800                   | 1.02                                | 1.06   | 1.10  | 1.14   | 1.24 |      |      |      |      |
| CBN-LRF 2004-003015 |                           | 1.5              | 50                     |                   |                          |                           |                  | 4                       | 28,800                   | 1.53                                | 1.59   | 1.64  | 1.71   | 1.85 |      |      |      |      |
| CBN-LRF 2004-005005 |                           | 0.5              | RO.05                  |                   |                          |                           |                  | 1                       | 50                       | 4                                   | 28,600 | 0.51  | 0.52   | 0.54 | 0.56 | 0.61 |      |      |
| CBN-LRF 2004-005010 |                           | 1                |                        |                   |                          |                           |                  | 50                      | 4                        | 28,800                              | 1.02   | 1.06  | 1.10   | 1.14 | 1.23 |      |      |      |
| CBN-LRF 2004-005015 |                           | 1.5              |                        |                   |                          |                           | 50               | 4                       | 28,800                   | 1.53                                | 1.58   | 1.64  | 1.70   | 1.84 |      |      |      |      |
| CBN-LRF 2004-005020 |                           | 2                |                        |                   |                          |                           | 50               | 4                       | 28,800                   | 2.05                                | 2.12   | 2.20  | 2.28   | 2.46 |      |      |      |      |
| CBN-LRF 2004-005040 |                           | 4                |                        |                   |                          |                           | 50               | 4                       | 29,800                   | 4.11                                | 4.26   | 4.41  | 4.58   | 4.95 |      |      |      |      |
| CBN-LRF 2004-010005 |                           | 0.5              | RO.1                   |                   |                          |                           | 0.5              | 0.3                     | 0.48                     | 15°                                 | 50     | 4     | 28,600 | 0.50 | 0.52 | 0.54 | 0.56 | 0.60 |
| CBN-LRF 2004-010010 |                           |                  |                        |                   |                          |                           | 1                |                         |                          |                                     | 50     | 4     | 28,800 | 1.02 | 1.06 | 1.09 | 1.13 | 1.22 |
| CBN-LRF 2004-010015 |                           |                  |                        |                   |                          |                           | 1.5              |                         |                          |                                     | 50     | 4     | 28,800 | 1.53 | 1.58 | 1.64 | 1.70 | 1.83 |
| CBN-LRF 2005-001010 | 1                         |                  |                        | 50                | 4                        | 26,400                    | 1.02             |                         |                          |                                     | 1.06   | 1.10  | 1.14   | 1.24 |      |      |      |      |
| CBN-LRF 2005-002005 | 0.5                       |                  |                        | RO.02             | 1                        | 50                        | 4                |                         |                          |                                     | 26,100 | 0.51  | 0.53   | 0.55 | 0.57 | 0.62 |      |      |
| CBN-LRF 2005-002010 | 1                         |                  | 50                     |                   | 4                        | 26,400                    | 1.02             |                         |                          |                                     | 1.06   | 1.10  | 1.14   | 1.24 |      |      |      |      |
| CBN-LRF 2005-002015 | 1.5                       |                  | 50                     |                   | 4                        | 26,600                    | 1.53             |                         |                          |                                     | 1.59   | 1.64  | 1.71   | 1.85 |      |      |      |      |
| CBN-LRF 2005-002020 | 2                         |                  | 50                     |                   | 4                        | 26,800                    | 2.05             |                         |                          |                                     | 2.12   | 2.20  | 2.28   | 2.47 |      |      |      |      |
| CBN-LRF 2005-003005 | 0.5                       |                  | RO.03                  |                   | 1                        | 50                        | 4                |                         |                          |                                     | 23,500 | 0.51  | 0.53   | 0.55 | 0.57 | 0.62 |      |      |
| CBN-LRF 2005-003010 | 1                         |                  |                        | 50                | 4                        | 23,700                    | 1.02             |                         |                          |                                     | 1.06   | 1.10  | 1.14   | 1.24 |      |      |      |      |
| CBN-LRF 2005-003015 | 1.5                       |                  |                        | 50                | 4                        | 23,900                    | 1.53             |                         |                          |                                     | 1.59   | 1.64  | 1.71   | 1.85 |      |      |      |      |
| CBN-LRF 2005-003020 | 2                         |                  |                        | 50                | 4                        | 24,100                    | 2.05             |                         |                          |                                     | 2.12   | 2.20  | 2.28   | 2.47 |      |      |      |      |
| CBN-LRF 2005-005005 | 0.5                       |                  |                        | RO.05             | 1                        | 50                        | 4                |                         |                          |                                     | 23,500 | 0.51  | 0.52   | 0.54 | 0.56 | 0.61 |      |      |
| CBN-LRF 2005-005010 | 1                         |                  | 50                     |                   | 4                        | 23,700                    | 1.02             |                         |                          |                                     | 1.06   | 1.10  | 1.14   | 1.23 |      |      |      |      |
| CBN-LRF 2005-005015 | 1.5                       |                  | 50                     |                   | 4                        | 23,900                    | 1.53             |                         |                          |                                     | 1.58   | 1.64  | 1.70   | 1.84 |      |      |      |      |
| CBN-LRF 2005-005020 | 2                         | 50               | 4                      |                   | 24,100                   | 2.05                      | 2.12             | 2.20                    | 2.28                     | 2.46                                |        |       |        |      |      |      |      |      |
| CBN-LRF 2005-010005 | 0.5                       | RO.1             | 1                      |                   | 50                       | 4                         | 23,500           | 0.50                    | 0.52                     | 0.54                                | 0.56   | 0.60  |        |      |      |      |      |      |
| CBN-LRF 2005-010010 | 1                         |                  | 50                     | 4                 | 23,700                   | 1.02                      | 1.06             | 1.09                    | 1.13                     | 1.22                                |        |       |        |      |      |      |      |      |
| CBN-LRF 2005-010015 | 1.5                       |                  | 50                     | 4                 | 23,900                   | 1.53                      | 1.58             | 1.64                    | 1.70                     | 1.83                                |        |       |        |      |      |      |      |      |
| CBN-LRF 2005-010020 | 2                         |                  | 50                     | 4                 | 24,100                   | 2.05                      | 2.12             | 2.19                    | 2.27                     | 2.45                                |        |       |        |      |      |      |      |      |
| CBN-LRF 2006-002005 | 0.6                       |                  | RO.02                  | 0.5               | 0.3                      | 0.58                      | 15°              | 50                      | 4                        | 26,100                              | 0.51   | 0.53  | 0.55   | 0.57 | 0.62 |      |      |      |
| CBN-LRF 2006-002010 |                           | 1                |                        | 50                |                          |                           |                  | 4                       | 26,400                   | 1.02                                | 1.06   | 1.10  | 1.14   | 1.24 |      |      |      |      |
| CBN-LRF 2006-002015 |                           | 1.5              |                        | 50                |                          |                           |                  | 4                       | 26,600                   | 1.53                                | 1.59   | 1.64  | 1.71   | 1.85 |      |      |      |      |
| CBN-LRF 2006-005005 |                           | 0.5              |                        | RO.05             |                          |                           |                  | 1                       | 50                       | 4                                   | 23,500 | 0.51  | 0.52   | 0.54 | 0.56 | 0.61 |      |      |
| CBN-LRF 2006-005010 |                           | 1                |                        |                   |                          |                           |                  | 50                      | 4                        | 23,700                              | 1.02   | 1.06  | 1.10   | 1.14 | 1.23 |      |      |      |
| CBN-LRF 2006-005015 |                           | 1.5              | 50                     |                   |                          |                           |                  | 4                       | 23,900                   | 1.53                                | 1.58   | 1.64  | 1.70   | 1.84 |      |      |      |      |
| CBN-LRF 2006-005030 |                           | 3                | 50                     |                   |                          |                           |                  | 4                       | 26,100                   | 3.08                                | 3.19   | 3.30  | 3.43   | 3.71 |      |      |      |      |
| CBN-LRF 2006-010005 |                           | 0.5              | RO.1                   |                   |                          |                           |                  | 1                       | 50                       | 4                                   | 23,500 | 0.50  | 0.52   | 0.54 | 0.56 | 0.60 |      |      |
| CBN-LRF 2006-010010 |                           | 1                |                        | 50                |                          |                           |                  | 4                       | 23,700                   | 1.02                                | 1.06   | 1.09  | 1.13   | 1.22 |      |      |      |      |
| CBN-LRF 2006-010015 |                           | 1.5              |                        | 50                |                          |                           |                  | 4                       | 23,900                   | 1.53                                | 1.58   | 1.64  | 1.70   | 1.83 |      |      |      |      |
| CBN-LRF 2008-002010 |                           | 1                |                        | RO.02             |                          |                           |                  | 1.5                     | 50                       | 4                                   | 26,600 | 1.02  | 1.06   | 1.10 | 1.14 | 1.24 |      |      |
| CBN-LRF 2008-002015 |                           | 2                |                        |                   |                          |                           |                  | 50                      | 4                        | 26,600                              | 1.53   | 1.59  | 1.64   | 1.71 | 1.85 |      |      |      |
| CBN-LRF 2008-002020 |                           | 2                | 50                     |                   |                          |                           |                  | 4                       | 26,600                   | 2.05                                | 2.12   | 2.20  | 2.28   | 2.47 |      |      |      |      |
| CBN-LRF 2008-002050 |                           | 5                | 50                     |                   |                          |                           |                  | 4                       | 30,100                   | 5.15                                | 5.33   | 5.52  | 5.73   | 6.20 |      |      |      |      |
| CBN-LRF 2008-005010 |                           | 1                | RO.05                  |                   |                          |                           |                  | 1.5                     | 50                       | 4                                   | 23,900 | 1.02  | 1.06   | 1.10 | 1.14 | 1.23 |      |      |
| CBN-LRF 2008-005015 | 2                         | 50               |                        | 4                 | 23,900                   | 1.53                      | 1.58             | 1.64                    | 1.70                     | 1.84                                |        |       |        |      |      |      |      |      |
| CBN-LRF 2008-005020 | 2                         | 50               |                        | 4                 | 23,900                   | 2.05                      | 2.12             | 2.20                    | 2.28                     | 2.46                                |        |       |        |      |      |      |      |      |
| CBN-LRF 2008-005050 | 5                         | 50               |                        | 4                 | 27,000                   | 5.15                      | 5.33             | 5.52                    | 5.73                     | 6.19                                |        |       |        |      |      |      |      |      |
| CBN-LRF 2008-010010 | 1                         | RO.1             |                        | 1                 | 50                       | 4                         | 23,900           | 1.02                    | 1.06                     | 1.09                                | 1.13   | 1.22  |        |      |      |      |      |      |
| CBN-LRF 2008-010015 | 1.5                       |                  | 50                     | 4                 | 23,900                   | 1.53                      | 1.58             | 1.64                    | 1.70                     | 1.83                                |        |       |        |      |      |      |      |      |
| CBN-LRF 2008-010020 | 2                         |                  | 50                     | 4                 | 23,900                   | 2.05                      | 2.12             | 2.19                    | 2.27                     | 2.45                                |        |       |        |      |      |      |      |      |
| CBN-LRF 2008-010050 | 5                         |                  | 50                     | 4                 | 27,000                   | 5.15                      | 5.32             | 5.52                    | 5.72                     | 6.18                                |        |       |        |      |      |      |      |      |

$\phi 3$ mm Shank V Series

UDC-PCD Series

CBN Series

Square Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



| Model Number          | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |        |       |        |       |      |
|-----------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|--------|-------|--------|-------|------|
|                       |                           |                  |                           |                      |                          |                       |                  |                         |                          | 30°                                 | 1°     | 1°30' | 2°     | 3°    |      |
| CBN-LRF 2010-002010   | 1                         | RO.02            | 1                         | 0.7                  | 0.98                     | 15°                   | 50               | 4                       | 24,400                   | 1.03                                | 1.06   | 1.10  | 1.15   | 1.24  |      |
| CBN-LRF 2010-002020   |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 24,400                   | 2.06                                | 2.13   | 2.21  | 2.30   | 2.48  |      |
| CBN-LRF 2010-002030   |                           |                  | 3                         |                      |                          |                       | 50               | 4                       | 24,400                   | 3.09                                | 3.20   | 3.32  | 3.45   | 3.73  |      |
| CBN-LRF 2010-002050   |                           |                  | 5                         |                      |                          |                       | 50               | 4                       | 27,600                   | 5.16                                | 5.34   | 5.54  | 5.74   | 6.21  |      |
| CBN-LRF 2010-005010   |                           |                  | 1                         |                      |                          |                       | RO.05            | 1                       | 50                       | 4                                   | 21,900 | 1.03  | 1.06   | 1.10  | 1.14 |
| CBN-LRF 2010-005020   |                           | 2                | 50                        |                      |                          |                       |                  | 4                       | 21,900                   | 2.06                                | 2.13   | 2.21  | 2.29   | 2.48  |      |
| CBN-LRF 2010-005030   |                           | 3                | 50                        |                      |                          |                       |                  | 4                       | 21,900                   | 3.09                                | 3.20   | 3.32  | 3.44   | 3.72  |      |
| CBN-LRF 2010-005050   |                           | 5                | 50                        |                      |                          |                       |                  | 4                       | 24,800                   | 5.16                                | 5.34   | 5.53  | 5.74   | 6.21  |      |
| CBN-LRF 2010-010010   |                           | 1                | RO.1                      |                      |                          |                       |                  | 1                       | 50                       | 4                                   | 21,900 | 1.02  | 1.06   | 1.09  | 1.13 |
| CBN-LRF 2010-010020   |                           | 2                |                           |                      |                          |                       | 50               | 4                       | 21,900                   | 2.06                                | 2.13   | 2.20  | 2.28   | 2.47  |      |
| CBN-LRF 2010-010030   |                           | 3                |                           |                      |                          |                       | 50               | 4                       | 21,900                   | 3.09                                | 3.20   | 3.31  | 3.43   | 3.71  |      |
| CBN-LRF 2010-010050   |                           | 5                |                           |                      |                          |                       | 50               | 4                       | 24,800                   | 5.16                                | 5.34   | 5.53  | 5.73   | 6.20  |      |
| CBN-LRF 2010-020010   |                           | 1                | RO.2                      |                      |                          |                       | 1                | 50                      | 4                        | 21,900                              | 1.02   | 1.05  | 1.08   | 1.12  | 1.20 |
| CBN-LRF 2010-020020   |                           | 2                |                           |                      |                          |                       | 50               | 4                       | 21,900                   | 2.05                                | 2.12   | 2.19  | 2.27   | 2.44  |      |
| CBN-LRF 2015-002030   |                           | 1.5              | RO.02                     |                      |                          |                       | 3                | 1                       | 1.46                     | 15°                                 | 50     | 4     | 28,700 | 3.13  | 3.24 |
| CBN-LRF 2015-002040   | 4                         |                  |                           | 50                   | 4                        | 28,700                | 4.17             |                         |                          |                                     | 4.31   | 4.47  | 4.64   | 5.02  |      |
| CBN-LRF 2015-002060   | 6                         |                  |                           | 50                   | 4                        | 28,700                | 6.23             |                         |                          |                                     | 6.45   | 6.69  | 6.94   | 7.50  |      |
| CBN-LRF 2015-005030   | RO.05                     |                  | 3                         | 50                   | 4                        | 25,800                | 3.13             |                         |                          |                                     | 3.24   | 3.36  | 3.48   | 3.77  |      |
| CBN-LRF 2015-005040   |                           |                  | 4                         | 50                   | 4                        | 25,800                | 4.16             |                         |                          |                                     | 4.31   | 4.47  | 4.63   | 5.01  |      |
| CBN-LRF 2015-005060   |                           |                  | 6                         | 50                   | 4                        | 25,800                | 6.23             |                         |                          |                                     | 6.45   | 6.68  | 6.93   | 7.50  |      |
| CBN-LRF 2015-010030   | RO.1                      |                  | 3                         | 50                   | 4                        | 25,800                | 3.13             |                         |                          |                                     | 3.24   | 3.35  | 3.48   | 3.76  |      |
| CBN-LRF 2015-010040   |                           |                  | 4                         | 50                   | 4                        | 25,800                | 4.16             |                         |                          |                                     | 4.31   | 4.46  | 4.63   | 5.00  |      |
| CBN-LRF 2015-010060   |                           |                  | 6                         | 50                   | 4                        | 25,800                | 6.23             |                         |                          |                                     | 6.45   | 6.68  | 6.93   | 7.48  |      |
| CBN-LRF 2015-030045   | RO.3                      |                  | 4.5                       | 50                   | 4                        | 25,800                | 4.67             |                         |                          |                                     | 4.83   | 4.99  | 5.17   | 5.57  |      |
| CBN-LRF 2020-002040   | 2                         | RO.02            | 4                         | 1.2                  | 1.97                     | 15°                   | 50               | 4                       | 29,600                   | 4.15                                | 4.29   | 4.45  | 4.62   | 4.99  |      |
| CBN-LRF 2020-002060   |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 29,600                   | 6.21                                | 6.43   | 6.67  | 6.92   | 7.48  |      |
| CBN-LRF 2020-002080   |                           |                  | 8                         |                      |                          |                       | 50               | 4                       | 31,300                   | 8.28                                | 8.57   | 8.88  | 9.22   | 9.97  |      |
| CBN-LRF 2020-002100   |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 33,000                   | 10.35                               | 10.71  | 11.10 | 11.52  | 12.45 |      |
| CBN-LRF 2020-003030   |                           | RO.03            | 3                         |                      |                          |                       | 50               | 4                       | 26,600                   | 3.11                                | 3.22   | 3.34  | 3.47   | 3.75  |      |
| CBN-LRF 2020-005040   |                           | RO.05            | 4                         |                      |                          |                       | 50               | 4                       | 26,600                   | 4.15                                | 4.29   | 4.45  | 4.61   | 4.99  |      |
| CBN-LRF 2020-005060   |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 26,600                   | 6.21                                | 6.43   | 6.66  | 6.91   | 7.47  |      |
| CBN-LRF 2020-005080   |                           |                  | 8                         |                      |                          |                       | 50               | 4                       | 28,150                   | 8.28                                | 8.57   | 8.88  | 9.21   | 9.96  |      |
| CBN-LRF 2020-005100   |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 29,700                   | 10.35                               | 10.71  | 11.10 | 11.51  | 12.45 |      |
| CBN-LRF 2020-010040   |                           | RO.1             | 4                         |                      |                          |                       | 50               | 4                       | 26,600                   | 4.14                                | 4.29   | 4.44  | 4.60   | 4.98  |      |
| CBN-LRF 2020-010060   |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 26,600                   | 6.21                                | 6.43   | 6.66  | 6.90   | 7.46  |      |
| CBN-LRF 2020-010080   |                           |                  | 8                         |                      |                          |                       | 50               | 4                       | 28,150                   | 8.28                                | 8.57   | 8.87  | 9.20   | 9.95  |      |
| CBN-LRF 2020-010100   |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 29,700                   | 10.35                               | 10.70  | 11.09 | 11.50  | 12.43 |      |
| CBN-LRF 2020-020040   |                           |                  | RO.2                      |                      |                          |                       | 4                | 50                      | 4                        | 26,600                              | 4.14   | 4.28  | 4.43   | 4.59  | 4.95 |
| CBN-LRF 2020-020060   |                           |                  |                           |                      |                          |                       | 6                | 50                      | 4                        | 26,600                              | 6.21   | 6.42  | 6.65   | 6.89  | 7.44 |
| CBN-LRF 2020-020080   |                           | 8                |                           |                      |                          |                       | 50               | 4                       | 28,150                   | 8.28                                | 8.56   | 8.86  | 9.19   | 9.92  |      |
| CBN-LRF 2020-020100   |                           | 10               |                           |                      |                          |                       | 50               | 4                       | 29,700                   | 10.34                               | 10.70  | 11.08 | 11.49  | 12.41 |      |
| CBN-LRF 2020-050040   |                           | RO.5             | 4                         |                      |                          |                       | 50               | 4                       | 26,600                   | 4.13                                | 4.26   | 4.40  | 4.55   | 4.88  |      |
| CBN-LRF 2020-050060   |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 26,600                   | 6.20                                | 6.40   | 6.61  | 6.85   | 7.37  |      |
| CBN-LRF 2020-050080   |                           |                  | 8                         |                      |                          |                       | 50               | 4                       | 28,150                   | 8.27                                | 8.54   | 8.83  | 9.15   | 9.85  |      |
| CBN-LRF 2020-050100   | 10                        |                  | 50                        | 4                    | 29,700                   | 10.33                 | 10.68            | 11.05                   | 11.45                    | 12.34                               |        |       |        |       |      |
| ※ CBN-LRF 2030-005060 | 3                         | RO.05            | 6                         | 0.7                  | 2.94                     | 15°                   | 50               | 6                       | 34,410                   | 6.27                                | 6.49   | 6.72  | 6.98   | 7.54  |      |
| ※ CBN-LRF 2030-010060 |                           | RO.1             | 6                         |                      |                          |                       | 50               | 6                       | 34,410                   | 6.27                                | 6.49   | 6.72  | 6.97   | 7.53  |      |
| ※ CBN-LRF 2030-020060 |                           | RO.2             | 6                         |                      |                          |                       | 50               | 6                       | 34,410                   | 6.27                                | 6.48   | 6.71  | 6.95   | 7.51  |      |
| ※ CBN-LRF 2030-050060 |                           | RO.5             | 6                         |                      |                          |                       | 50               | 6                       | 34,410                   | 6.26                                | 6.46   | 6.68  | 6.91   | 7.44  |      |

※ Additional model

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Milling Conditions for CBN-LRF (2 Flutes)

| WORK MATERIAL |                       |                    |                       | HEAT-TREATED STEELS / HARDENED STEELS STAVAX (~52HRC) |                    |                                 |                                  | HARDENED STEELS SKD11 (~62HRC)     |                    |                                 |                                  | HARDENED STEELS HAP10 / HAP72 (~68HRC) |                    |                                 |                                  |      |
|---------------|-----------------------|--------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                    | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |      |
| 2001-002002   | 0.1                   | R0.02              | 0.2                   | 30,000  | 90                 | 0.002                           | 0.01                             | 30,000                             | 60                 | 0.002                           | 0.01                             | 30,000                                 | 30                 | 0.002                           | 0.005                            |      |
| 2001-002003   |                       |                    | 0.3                   | 30,000  | 90                 | 0.002                           | 0.01                             | 30,000                             | 60                 | 0.002                           | 0.01                             | 30,000                                 | 30                 | 0.002                           | 0.005                            |      |
| 2001-002005   |                       |                    | 0.5                   | 30,000  | 90                 | 0.002                           | 0.01                             | 30,000                             | 60                 | 0.002                           | 0.01                             | 30,000                                 | 30                 | 0.002                           | 0.005                            |      |
| 2001-003002   |                       | R0.03              | 0.2                   | 30,000  | 90                 | 0.002                           | 0.01                             | 30,000                             | 60                 | 0.002                           | 0.01                             | 30,000                                 | 30                 | 0.002                           | 0.005                            |      |
| 2001-003003   |                       |                    | 0.3                   | 30,000  | 90                 | 0.002                           | 0.01                             | 30,000                             | 60                 | 0.002                           | 0.01                             | 30,000                                 | 30                 | 0.002                           | 0.005                            |      |
| 2001-003005   |                       |                    | 0.5                   | 30,000  | 90                 | 0.002                           | 0.01                             | 30,000                             | 60                 | 0.002                           | 0.01                             | 30,000                                 | 30                 | 0.002                           | 0.005                            |      |
| 2001-002X2    |                       | 0.15               | R0.02                 | 0.2   | 30,000             | 120                             | 0.003                            | 0.015                              | 30,000             | 90                              | 0.003                            | 0.015                                  | 30,000             | 60                              | 0.002                            | 0.01 |
| 2001-002X3    |                       |                    |                       | 0.3   | 30,000             | 120                             | 0.003                            | 0.015                              | 30,000             | 90                              | 0.003                            | 0.015                                  | 30,000             | 60                              | 0.002                            | 0.01 |
| 2001-002X5    |                       |                    |                       | 0.5   | 30,000             | 120                             | 0.003                            | 0.015                              | 30,000             | 90                              | 0.003                            | 0.015                                  | 30,000             | 60                              | 0.002                            | 0.01 |
| 2001-003X2    | R0.03                 |                    | 0.2                   | 30,000  | 120                | 0.003                           | 0.015                            | 30,000                             | 90                 | 0.003                           | 0.015                            | 30,000                                 | 60                 | 0.002                           | 0.01                             |      |
| 2001-003X3    |                       |                    | 0.3                   | 30,000  | 120                | 0.003                           | 0.015                            | 30,000                             | 90                 | 0.003                           | 0.015                            | 30,000                                 | 60                 | 0.002                           | 0.01                             |      |
| 2001-003X5    |                       |                    | 0.5                   | 30,000  | 120                | 0.003                           | 0.015                            | 30,000                             | 90                 | 0.003                           | 0.015                            | 30,000                                 | 60                 | 0.002                           | 0.01                             |      |
| 2002-002005   | 0.2                   |                    | R0.02                 | 0.5   | 30,000             | 140                             | 0.003                            | 0.02                               | 30,000             | 120                             | 0.003                            | 0.02                                   | 30,000             | 80                              | 0.003                            | 0.01 |
| 2002-002X75   |                       |                    |                       | 0.75  | 30,000             | 140                             | 0.003                            | 0.02                               | 30,000             | 120                             | 0.003                            | 0.02                                   | 30,000             | 80                              | 0.003                            | 0.01 |
| 2002-002010   |                       |                    |                       | 1   | 30,000             | 140                             | 0.003                            | 0.02                               | 30,000             | 120                             | 0.003                            | 0.02                                   | 30,000             | 80                              | 0.003                            | 0.01 |
| 2002-003005   |                       | R0.03              | 0.5                   | 30,000  | 140                | 0.003                           | 0.02                             | 30,000                             | 120                | 0.003                           | 0.02                             | 30,000                                 | 80                 | 0.003                           | 0.01                             |      |
| 2002-003X75   |                       |                    | 0.75                  | 30,000  | 140                | 0.003                           | 0.02                             | 30,000                             | 120                | 0.003                           | 0.02                             | 30,000                                 | 80                 | 0.003                           | 0.01                             |      |
| 2002-003010   |                       |                    | 1                     | 30,000  | 140                | 0.003                           | 0.02                             | 30,000                             | 120                | 0.003                           | 0.02                             | 30,000                                 | 80                 | 0.003                           | 0.01                             |      |
| 2002-005005   |                       | R0.05              | 0.5                   | 30,000  | 140                | 0.003                           | 0.02                             | 30,000                             | 120                | 0.003                           | 0.02                             | 30,000                                 | 80                 | 0.003                           | 0.01                             |      |
| 2002-005X75   |                       |                    | 0.75                  | 30,000  | 140                | 0.003                           | 0.02                             | 30,000                             | 120                | 0.003                           | 0.02                             | 30,000                                 | 80                 | 0.003                           | 0.01                             |      |
| 2002-005010   |                       |                    | 1                     | 30,000  | 140                | 0.003                           | 0.02                             | 30,000                             | 120                | 0.003                           | 0.02                             | 30,000                                 | 80                 | 0.003                           | 0.01                             |      |
| 2002-005X5    | 0.25                  | R0.05              | 0.5                   | 30,000  | 190                | 0.004                           | 0.03                             | 30,000                             | 170                | 0.004                           | 0.03                             | 30,000                                 | 140                | 0.003                           | 0.015                            |      |
| 2002-005X75   |                       |                    | 0.75                  | 30,000  | 190                | 0.004                           | 0.03                             | 30,000                             | 170                | 0.004                           | 0.03                             | 30,000                                 | 140                | 0.003                           | 0.015                            |      |
| 2002-005010   |                       |                    | 1                     | 30,000  | 190                | 0.004                           | 0.03                             | 30,000                             | 170                | 0.004                           | 0.03                             | 30,000                                 | 140                | 0.003                           | 0.015                            |      |
| 2003-001010   | 0.3                   | R0.01              | 1                     | 30,000  | 185                | 0.003                           | 0.045                            | 30,000                             | 160                | 0.003                           | 0.045                            | 30,000                                 | 120                | 0.003                           | 0.02                             |      |
| 2003-002005   |                       | R0.02              | 0.5                   | 30,000  | 185                | 0.003                           | 0.045                            | 30,000                             | 160                | 0.003                           | 0.045                            | 30,000                                 | 120                | 0.003                           | 0.02                             |      |
| 2003-002X75   |                       |                    | 0.75                  | 30,000  | 185                | 0.003                           | 0.045                            | 30,000                             | 160                | 0.003                           | 0.045                            | 30,000                                 | 120                | 0.003                           | 0.02                             |      |
| 2003-002010   |                       |                    | 1                     | 30,000  | 185                | 0.003                           | 0.045                            | 30,000                             | 160                | 0.003                           | 0.045                            | 30,000                                 | 120                | 0.003                           | 0.02                             |      |
| 2003-002015   |                       | R0.03              | 1.5                   | 30,000  | 185                | 0.003                           | 0.045                            | 30,000                             | 160                | 0.003                           | 0.045                            | 30,000                                 | 120                | 0.003                           | 0.02                             |      |
| 2003-002020   |                       |                    | 2                     | 30,000  | 130                | 0.003                           | 0.022                            | 30,000                             | 110                | 0.003                           | 0.022                            | 30,000                                 | 80                 | 0.003                           | 0.01                             |      |
| 2003-003005   |                       |                    | 0.5                   | 30,000  | 200                | 0.004                           | 0.045                            | 30,000                             | 175                | 0.004                           | 0.045                            | 30,000                                 | 150                | 0.003                           | 0.02                             |      |
| 2003-003X75   |                       | R0.05              | 0.75                  | 30,000  | 200                | 0.004                           | 0.045                            | 30,000                             | 175                | 0.004                           | 0.045                            | 30,000                                 | 150                | 0.003                           | 0.02                             |      |
| 2003-003010   |                       |                    | 1                     | 30,000  | 200                | 0.004                           | 0.045                            | 30,000                             | 175                | 0.004                           | 0.045                            | 30,000                                 | 150                | 0.003                           | 0.02                             |      |
| 2003-003015   | 1.5                   |                    | 30,000                | 200   | 0.004              | 0.045                           | 30,000                           | 175                                | 0.004              | 0.045                           | 30,000                           | 150                                    | 0.003              | 0.02                            |                                  |      |
| 2003-003020   | R0.05                 | 2                  | 30,000                | 140   | 0.004              | 0.022                           | 30,000                           | 120                                | 0.004              | 0.022                           | 30,000                           | 110                                    | 0.003              | 0.01                            |                                  |      |
| 2003-005005   |                       | 0.5                | 30,000                | 240   | 0.005              | 0.045                           | 30,000                           | 225                                | 0.005              | 0.045                           | 30,000                           | 210                                    | 0.004              | 0.02                            |                                  |      |
| 2003-005X75   |                       | 0.75               | 30,000                | 240   | 0.005              | 0.045                           | 30,000                           | 225                                | 0.005              | 0.045                           | 30,000                           | 210                                    | 0.004              | 0.02                            |                                  |      |
| 2003-005010   |                       | 1                  | 30,000                | 240   | 0.005              | 0.045                           | 30,000                           | 225                                | 0.005              | 0.045                           | 30,000                           | 210                                    | 0.004              | 0.02                            |                                  |      |
| 2003-005015   |                       | 1.5                | 30,000                | 240   | 0.005              | 0.045                           | 30,000                           | 225                                | 0.005              | 0.045                           | 30,000                           | 210                                    | 0.004              | 0.02                            |                                  |      |
| 2003-005020   | 2                     | 30,000             | 170                   | 0.005   | 0.022              | 30,000                          | 160                              | 0.005                              | 0.022              | 30,000                          | 150                              | 0.004                                  | 0.01               |                                 |                                  |      |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for CBN-LRF (2 Flutes)

| WORK MATERIAL |                       |                    |                       | HEAT-TREATED STEELS / HARDENED STEELS<br>STAVAX<br>(~52HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10 / HAP72<br>(~68HRC) |                    |                                 |                                  |
|---------------|-----------------------|--------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|--------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )           | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2004-002005   | 0.4                   | R0.02              | 0.5                   | 30,000  | 230                | 0.005                           | 0.065                            | 30,000                               | 200                | 0.005                           | 0.065                            | 30,000                                       | 160                | 0.004                           | 0.02                             |
| 2004-002010   |                       |                    | 1                     | 30,000  | 230                | 0.005                           | 0.065                            | 30,000                               | 200                | 0.005                           | 0.065                            | 30,000                                       | 160                | 0.004                           | 0.02                             |
| 2004-002015   |                       |                    | 1.5                   | 30,000  | 230                | 0.005                           | 0.065                            | 30,000                               | 200                | 0.005                           | 0.065                            | 30,000                                       | 160                | 0.004                           | 0.02                             |
| 2004-002020   |                       |                    | 2                     | 30,000  | 230                | 0.005                           | 0.065                            | 30,000                               | 200                | 0.005                           | 0.065                            | 30,000                                       | 160                | 0.004                           | 0.02                             |
| 2004-003005   |                       | R0.03              | 0.5                   | 30,000  | 270                | 0.006                           | 0.065                            | 30,000                               | 230                | 0.006                           | 0.065                            | 30,000                                       | 180                | 0.004                           | 0.02                             |
| 2004-003010   |                       |                    | 1                     | 30,000  | 270                | 0.006                           | 0.065                            | 30,000                               | 230                | 0.006                           | 0.065                            | 30,000                                       | 180                | 0.004                           | 0.02                             |
| 2004-003015   |                       |                    | 1.5                   | 30,000  | 270                | 0.006                           | 0.065                            | 30,000                               | 230                | 0.006                           | 0.065                            | 30,000                                       | 180                | 0.004                           | 0.02                             |
| 2004-005005   |                       | R0.05              | 0.5                   | 30,000  | 340                | 0.01                            | 0.065                            | 30,000                               | 300                | 0.01                            | 0.065                            | 30,000                                       | 220                | 0.005                           | 0.02                             |
| 2004-005010   |                       |                    | 1                     | 30,000  | 340                | 0.01                            | 0.065                            | 30,000                               | 300                | 0.01                            | 0.065                            | 30,000                                       | 220                | 0.005                           | 0.02                             |
| 2004-005015   |                       |                    | 1.5                   | 30,000  | 340                | 0.01                            | 0.065                            | 30,000                               | 300                | 0.01                            | 0.065                            | 30,000                                       | 220                | 0.005                           | 0.02                             |
| 2004-005020   |                       |                    | 2                     | 30,000  | 340                | 0.01                            | 0.065                            | 30,000                               | 300                | 0.01                            | 0.065                            | 30,000                                       | 220                | 0.005                           | 0.02                             |
| 2004-005040   |                       | R0.1               | 4                     | 30,000  | 170                | 0.01                            | 0.032                            | 30,000                               | 150                | 0.01                            | 0.032                            | 30,000                                       | 110                | 0.005                           | 0.01                             |
| 2004-010005   |                       |                    | 0.5                   | 30,000  | 520                | 0.01                            | 0.065                            | 30,000                               | 450                | 0.01                            | 0.065                            | 30,000                                       | 320                | 0.005                           | 0.02                             |
| 2004-010010   |                       |                    | 1                     | 30,000  | 520                | 0.01                            | 0.065                            | 30,000                               | 450                | 0.01                            | 0.065                            | 30,000                                       | 320                | 0.005                           | 0.02                             |
| 2004-010015   |                       |                    | 1.5                   | 30,000  | 520                | 0.01                            | 0.065                            | 30,000                               | 450                | 0.01                            | 0.065                            | 30,000                                       | 320                | 0.005                           | 0.02                             |
| 2005-001010   |                       |                    | R0.01                 | 1   | 30,000             | 280                             | 0.003                            | 0.09                                 | 30,000             | 240                             | 0.003                            | 0.09   | 30,000             | 200                             | 0.003                            |
| 2005-002005   | R0.02                 | 0.5                | 30,000                | 280   | 0.005              | 0.09                            | 30,000                           | 240                                  | 0.005              | 0.09                            | 30,000                           | 200  | 0.005              | 0.03                            |                                  |
| 2005-002010   |                       | 1                  | 30,000                | 280   | 0.005              | 0.09                            | 30,000                           | 240                                  | 0.005              | 0.09                            | 30,000                           | 200  | 0.005              | 0.03                            |                                  |
| 2005-002015   |                       | 1.5                | 30,000                | 280   | 0.005              | 0.09                            | 30,000                           | 240                                  | 0.005              | 0.09                            | 30,000                           | 200  | 0.005              | 0.03                            |                                  |
| 2005-002020   |                       | 2                  | 30,000                | 280   | 0.005              | 0.09                            | 30,000                           | 240                                  | 0.005              | 0.09                            | 30,000                           | 200  | 0.005              | 0.03                            |                                  |
| 2005-003005   | R0.03                 | 0.5                | 30,000                | 330   | 0.006              | 0.09                            | 30,000                           | 280                                  | 0.006              | 0.09                            | 30,000                           | 230  | 0.005              | 0.03                            |                                  |
| 2005-003010   |                       | 1                  | 30,000                | 330   | 0.006              | 0.09                            | 30,000                           | 280                                  | 0.006              | 0.09                            | 30,000                           | 230  | 0.005              | 0.03                            |                                  |
| 2005-003015   |                       | 1.5                | 30,000                | 330   | 0.006              | 0.09                            | 30,000                           | 280                                  | 0.006              | 0.09                            | 30,000                           | 230  | 0.005              | 0.03                            |                                  |
| 2005-003020   | R0.05                 | 2                  | 30,000                | 330   | 0.006              | 0.09                            | 30,000                           | 280                                  | 0.006              | 0.09                            | 30,000                           | 230  | 0.005              | 0.03                            |                                  |
| 2005-005005   |                       | 0.5                | 30,000                | 440   | 0.01               | 0.09                            | 30,000                           | 380                                  | 0.01               | 0.09                            | 30,000                           | 280  | 0.01               | 0.03                            |                                  |
| 2005-005010   |                       | 1                  | 30,000                | 440   | 0.01               | 0.09                            | 30,000                           | 380                                  | 0.01               | 0.09                            | 30,000                           | 280  | 0.01               | 0.03                            |                                  |
| 2005-005015   |                       | 1.5                | 30,000                | 440   | 0.01               | 0.09                            | 30,000                           | 380                                  | 0.01               | 0.09                            | 30,000                           | 280  | 0.01               | 0.03                            |                                  |
| 2005-005020   | R0.1                  | 2                  | 30,000                | 440   | 0.01               | 0.09                            | 30,000                           | 380                                  | 0.01               | 0.09                            | 30,000                           | 280  | 0.01               | 0.03                            |                                  |
| 2005-010005   |                       | 0.5                | 30,000                | 700   | 0.02               | 0.09                            | 30,000                           | 600                                  | 0.02               | 0.09                            | 30,000                           | 410  | 0.01               | 0.03                            |                                  |
| 2005-010010   |                       | 1                  | 30,000                | 700   | 0.02               | 0.09                            | 30,000                           | 600                                  | 0.02               | 0.09                            | 30,000                           | 410  | 0.01               | 0.03                            |                                  |
| 2005-010015   | 1.5                   | 30,000             | 700                   | 0.02  | 0.09               | 30,000                          | 600                              | 0.02                                 | 0.09               | 30,000                          | 410                              | 0.01   | 0.03               |                                 |                                  |
| 2005-010020   | 2                     | 30,000             | 700                   | 0.02  | 0.09               | 30,000                          | 600                              | 0.02                                 | 0.09               | 30,000                          | 410                              | 0.01   | 0.03               |                                 |                                  |
| 2006-002005   | 0.6                   | R0.02              | 0.5                   | 30,000  | 320                | 0.005                           | 0.11                             | 30,000                               | 270                | 0.005                           | 0.11                             | 30,000                                       | 240                | 0.005                           | 0.035                            |
| 2006-002010   |                       |                    | 1                     | 30,000  | 320                | 0.005                           | 0.11                             | 30,000                               | 270                | 0.005                           | 0.11                             | 30,000                                       | 240                | 0.005                           | 0.035                            |
| 2006-002015   |                       |                    | 1.5                   | 30,000  | 320                | 0.005                           | 0.11                             | 30,000                               | 270                | 0.005                           | 0.11                             | 30,000                                       | 240                | 0.005                           | 0.035                            |
| 2006-005005   |                       | R0.05              | 0.5                   | 30,000  | 500                | 0.01                            | 0.11                             | 30,000                               | 430                | 0.01                            | 0.11                             | 30,000                                       | 340                | 0.01                            | 0.035                            |
| 2006-005010   |                       |                    | 1                     | 30,000  | 500                | 0.01                            | 0.11                             | 30,000                               | 430                | 0.01                            | 0.11                             | 30,000                                       | 340                | 0.01                            | 0.035                            |
| 2006-005015   |                       |                    | 1.5                   | 30,000  | 500                | 0.01                            | 0.11                             | 30,000                               | 430                | 0.01                            | 0.11                             | 30,000                                       | 340                | 0.01                            | 0.035                            |
| 2006-005030   |                       |                    | 3                     | 30,000  | 500                | 0.01                            | 0.11                             | 30,000                               | 430                | 0.01                            | 0.11                             | 30,000                                       | 340                | 0.01                            | 0.035                            |
| 2006-010005   |                       | R0.1               | 0.5                   | 30,000  | 800                | 0.02                            | 0.11                             | 30,000                               | 675                | 0.02                            | 0.11                             | 30,000                                       | 492                | 0.01                            | 0.035                            |
| 2006-010010   |                       |                    | 1                     | 30,000  | 800                | 0.02                            | 0.11                             | 30,000                               | 675                | 0.02                            | 0.11                             | 30,000                                       | 492                | 0.01                            | 0.035                            |
| 2006-010015   |                       |                    | 1.5                   | 30,000  | 800                | 0.02                            | 0.11                             | 30,000                               | 675                | 0.02                            | 0.11                             | 30,000                                       | 492                | 0.01                            | 0.035                            |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
Square

Radius

Long Neck  
Radius  
Taper Neck  
RadiusBall / Long  
Shank Ball  
Long Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for CBN-LRF (2 Flutes)

| WORK MATERIAL |                       |                    |                       | HEAT-TREATED STEELS / HARDENED STEELS<br>STAVAX (~52HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11 (~62HRC)  |                    |                                 |                                  | HARDENED STEELS<br>HAP10 / HAP72 (~68HRC) |                    |                                 |                                  |      |
|---------------|-----------------------|--------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )        | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |      |
| 2008-002010   | 0.8                   | R0.02              | 1                     | 30,000   | 410                | 0.005                           | 0.16                             | 30,000                             | 350                | 0.005                           | 0.16                             | 30,000                                    | 320                | 0.005                           | 0.04                             |      |
| 2008-002015   |                       |                    | 1.5                   | 30,000   | 410                | 0.005                           | 0.16                             | 30,000                             | 350                | 0.005                           | 0.16                             | 30,000                                    | 320                | 0.005                           | 0.04                             |      |
| 2008-002020   |                       |                    | 2                     | 30,000   | 410                | 0.005                           | 0.16                             | 30,000                             | 350                | 0.005                           | 0.16                             | 30,000                                    | 320                | 0.005                           | 0.04                             |      |
| 2008-002050   |                       |                    | 5                     | 30,000   | 290                | 0.005                           | 0.08                             | 30,000                             | 250                | 0.005                           | 0.08                             | 30,000                                    | 220                | 0.005                           | 0.02                             |      |
| 2008-005010   |                       | R0.05              | 1                     | 30,000   | 600                | 0.01                            | 0.16                             | 30,000                             | 510                | 0.01                            | 0.16                             | 30,000                                    | 450                | 0.01                            | 0.04                             |      |
| 2008-005015   |                       |                    | 1.5                   | 30,000   | 600                | 0.01                            | 0.16                             | 30,000                             | 510                | 0.01                            | 0.16                             | 30,000                                    | 450                | 0.01                            | 0.04                             |      |
| 2008-005020   |                       |                    | 2                     | 30,000   | 600                | 0.01                            | 0.16                             | 30,000                             | 510                | 0.01                            | 0.16                             | 30,000                                    | 450                | 0.01                            | 0.04                             |      |
| 2008-005050   |                       | 5                  | 30,000                | 420  | 0.01               | 0.08                            | 30,000                           | 360                                | 0.01               | 0.08                            | 30,000                           | 320                                       | 0.01               | 0.02                            |                                  |      |
| 2008-010010   |                       | R0.1               | 1                     | 30,000   | 920                | 0.02                            | 0.16                             | 30,000                             | 790                | 0.02                            | 0.16                             | 30,000                                    | 560                | 0.01                            | 0.04                             |      |
| 2008-010015   |                       |                    | 1.5                   | 30,000   | 920                | 0.02                            | 0.16                             | 30,000                             | 790                | 0.02                            | 0.16                             | 30,000                                    | 560                | 0.01                            | 0.04                             |      |
| 2008-010020   |                       |                    | 2                     | 30,000   | 920                | 0.02                            | 0.16                             | 30,000                             | 790                | 0.02                            | 0.16                             | 30,000                                    | 560                | 0.01                            | 0.04                             |      |
| 2008-010050   |                       |                    | 5                     | 30,000   | 640                | 0.02                            | 0.08                             | 30,000                             | 550                | 0.02                            | 0.08                             | 30,000                                    | 390                | 0.01                            | 0.02                             |      |
| 2010-002010   |                       | 1                  | R0.02                 | 1  | 30,000             | 500                             | 0.005                            | 0.2                                | 30,000             | 430                             | 0.005                            | 0.2                                       | 30,000             | 400                             | 0.005                            | 0.05 |
| 2010-002020   |                       |                    |                       | 2  | 30,000             | 500                             | 0.005                            | 0.2                                | 30,000             | 430                             | 0.005                            | 0.2                                       | 30,000             | 400                             | 0.005                            | 0.05 |
| 2010-002030   |                       |                    |                       | 3  | 30,000             | 500                             | 0.005                            | 0.2                                | 30,000             | 430                             | 0.005                            | 0.2                                       | 30,000             | 400                             | 0.005                            | 0.05 |
| 2010-002050   |                       |                    |                       | 5  | 30,000             | 500                             | 0.005                            | 0.2                                | 30,000             | 430                             | 0.005                            | 0.2                                       | 30,000             | 400                             | 0.005                            | 0.05 |
| 2010-005010   | R0.05                 |                    | 1                     | 30,000   | 700                | 0.01                            | 0.2                              | 30,000                             | 600                | 0.01                            | 0.2                              | 30,000                                    | 500                | 0.01                            | 0.05                             |      |
| 2010-005020   |                       |                    | 2                     | 30,000   | 700                | 0.01                            | 0.2                              | 30,000                             | 600                | 0.01                            | 0.2                              | 30,000                                    | 500                | 0.01                            | 0.05                             |      |
| 2010-005030   |                       |                    | 3                     | 30,000   | 700                | 0.01                            | 0.2                              | 30,000                             | 600                | 0.01                            | 0.2                              | 30,000                                    | 500                | 0.01                            | 0.05                             |      |
| 2010-005050   | 5                     |                    | 30,000                | 700  | 0.01               | 0.2                             | 30,000                           | 600                                | 0.01               | 0.2                             | 30,000                           | 500                                       | 0.01               | 0.05                            |                                  |      |
| 2010-010010   | R0.1                  |                    | 1                     | 30,000   | 1,000              | 0.02                            | 0.2                              | 30,000                             | 850                | 0.02                            | 0.2                              | 30,000                                    | 600                | 0.01                            | 0.05                             |      |
| 2010-010020   |                       |                    | 2                     | 30,000   | 1,000              | 0.02                            | 0.2                              | 30,000                             | 850                | 0.02                            | 0.2                              | 30,000                                    | 600                | 0.01                            | 0.05                             |      |
| 2010-010030   |                       |                    | 3                     | 30,000   | 1,000              | 0.02                            | 0.2                              | 30,000                             | 850                | 0.02                            | 0.2                              | 30,000                                    | 600                | 0.01                            | 0.05                             |      |
| 2010-010050   |                       |                    | 5                     | 30,000   | 1,000              | 0.02                            | 0.2                              | 30,000                             | 850                | 0.02                            | 0.2                              | 30,000                                    | 600                | 0.01                            | 0.05                             |      |
| 2010-020010   | R0.2                  |                    | 1                     | 30,000   | 1,600              | 0.04                            | 0.2                              | 30,000                             | 1,350              | 0.04                            | 0.2                              | 30,000                                    | 850                | 0.01                            | 0.05                             |      |
| 2010-020020   |                       |                    | 2                     | 30,000   | 1,600              | 0.04                            | 0.2                              | 30,000                             | 1,350              | 0.04                            | 0.2                              | 30,000                                    | 850                | 0.01                            | 0.05                             |      |
| 2015-002030   | 1.5                   |                    | R0.02                 | 3  | 27,000             | 800                             | 0.005                            | 0.3                                | 27,000             | 680                             | 0.005                            | 0.3                                       | 20,000             | 470                             | 0.005                            | 0.23 |
| 2015-002040   |                       |                    |                       | 4  | 27,000             | 800                             | 0.005                            | 0.3                                | 27,000             | 680                             | 0.005                            | 0.3                                       | 20,000             | 470                             | 0.005                            | 0.23 |
| 2015-002060   |                       | 6                  |                       | 27,000   | 800                | 0.005                           | 0.3                              | 27,000                             | 680                | 0.005                           | 0.3                              | 20,000                                    | 470                | 0.005                           | 0.23                             |      |
| 2015-005030   |                       | R0.05              | 3                     | 27,000   | 1,200              | 0.01                            | 0.3                              | 27,000                             | 1,000              | 0.01                            | 0.3                              | 20,000                                    | 520                | 0.01                            | 0.23                             |      |
| 2015-005040   |                       |                    | 4                     | 27,000   | 1,200              | 0.01                            | 0.3                              | 27,000                             | 1,000              | 0.01                            | 0.3                              | 20,000                                    | 520                | 0.01                            | 0.23                             |      |
| 2015-005060   |                       |                    | 6                     | 27,000   | 1,200              | 0.01                            | 0.3                              | 27,000                             | 1,000              | 0.01                            | 0.3                              | 20,000                                    | 520                | 0.01                            | 0.23                             |      |
| 2015-010030   |                       | R0.1               | 3                     | 27,000   | 1,500              | 0.02                            | 0.3                              | 27,000                             | 1,300              | 0.02                            | 0.3                              | 20,000                                    | 600                | 0.01                            | 0.23                             |      |
| 2015-010040   |                       |                    | 4                     | 27,000   | 1,500              | 0.02                            | 0.3                              | 27,000                             | 1,300              | 0.02                            | 0.3                              | 20,000                                    | 600                | 0.01                            | 0.23                             |      |
| 2015-010060   |                       |                    | 6                     | 27,000   | 1,500              | 0.02                            | 0.3                              | 27,000                             | 1,300              | 0.02                            | 0.3                              | 20,000                                    | 600                | 0.01                            | 0.23                             |      |
| 2015-030045   |                       | R0.3               | 4.5                   | 27,000   | 1,800              | 0.06                            | 0.3                              | 27,000                             | 1,500              | 0.06                            | 0.3                              | 25,000                                    | 930                | 0.01                            | 0.23                             |      |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

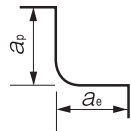
Technical Data

## Milling Conditions for CBN-LRF (2 Flutes)

| WORK MATERIAL |                       |                    |                       | HEAT-TREATED STEELS / HARDENED STEELS<br>STAVAX<br>(~52HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10 / HAP72<br>(~68HRC) |                    |                                 |                                  |     |
|---------------|-----------------------|--------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|--------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|-----|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )           | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |     |
| 2020-002040   | 2                     | R0.02              | 4                     | 24,000  | 1,000              | 0.005                           | 0.4                              | 24,000                               | 850                | 0.005                           | 0.4                              | 16,000                                       | 530                | 0.005                           | 0.4                              |     |
| 2020-002060   |                       |                    | 6                     | 24,000  | 1,000              | 0.005                           | 0.4                              | 24,000                               | 850                | 0.005                           | 0.4                              | 16,000                                       | 530                | 0.005                           | 0.4                              |     |
| 2020-002080   |                       |                    | 8                     | 24,000  | 1,000              | 0.005                           | 0.4                              | 24,000                               | 850                | 0.005                           | 0.4                              | 16,000                                       | 530                | 0.005                           | 0.4                              |     |
| 2020-002100   |                       |                    | 10                    | 24,000  | 1,000              | 0.005                           | 0.4                              | 24,000                               | 850                | 0.005                           | 0.4                              | 16,000                                       | 530                | 0.005                           | 0.4                              |     |
| 2020-003030   |                       | R0.03              | 3                     | 24,000  | 1,000              | 0.006                           | 0.4                              | 24,000                               | 850                | 0.006                           | 0.4                              | 16,000                                       | 550                | 0.005                           | 0.4                              |     |
| 2020-005040   |                       | R0.05              | 4                     | 24,000  | 1,500              | 0.01                            | 0.4                              | 24,000                               | 1,300              | 0.01                            | 0.4                              | 16,500                                       | 600                | 0.01                            | 0.4                              |     |
| 2020-005060   |                       |                    | 6                     | 24,000  | 1,500              | 0.01                            | 0.4                              | 24,000                               | 1,300              | 0.01                            | 0.4                              | 16,500                                       | 600                | 0.01                            | 0.4                              |     |
| 2020-005080   |                       |                    | 8                     | 24,000  | 1,500              | 0.01                            | 0.4                              | 24,000                               | 1,300              | 0.01                            | 0.4                              | 16,500                                       | 600                | 0.01                            | 0.35                             |     |
| 2020-005100   |                       |                    | 10                    | 24,000  | 1,500              | 0.01                            | 0.4                              | 24,000                               | 1,300              | 0.01                            | 0.4                              | 16,500                                       | 600                | 0.01                            | 0.3                              |     |
| 2020-010040   |                       | R0.1               | 4                     | 24,000  | 2,000              | 0.02                            | 0.4                              | 24,000                               | 1,700              | 0.02                            | 0.4                              | 17,000                                       | 700                | 0.01                            | 0.4                              |     |
| 2020-010060   |                       |                    | 6                     | 24,000  | 2,000              | 0.02                            | 0.4                              | 24,000                               | 1,700              | 0.02                            | 0.4                              | 17,000                                       | 700                | 0.01                            | 0.4                              |     |
| 2020-010080   |                       |                    | 8                     | 24,000  | 2,000              | 0.02                            | 0.4                              | 24,000                               | 1,700              | 0.02                            | 0.4                              | 17,000                                       | 700                | 0.01                            | 0.35                             |     |
| 2020-010100   |                       |                    | 10                    | 24,000  | 2,000              | 0.02                            | 0.4                              | 24,000                               | 1,700              | 0.02                            | 0.4                              | 17,000                                       | 700                | 0.01                            | 0.3                              |     |
| 2020-020040   |                       | R0.2               | 4                     | 24,000  | 2,000              | 0.04                            | 0.4                              | 24,000                               | 1,700              | 0.04                            | 0.4                              | 17,700                                       | 770                | 0.01                            | 0.4                              |     |
| 2020-020060   |                       |                    | 6                     | 24,000  | 2,000              | 0.04                            | 0.4                              | 24,000                               | 1,700              | 0.04                            | 0.4                              | 17,700                                       | 770                | 0.01                            | 0.4                              |     |
| 2020-020080   |                       |                    | 8                     | 24,000  | 2,000              | 0.03                            | 0.4                              | 24,000                               | 1,700              | 0.03                            | 0.4                              | 17,700                                       | 770                | 0.01                            | 0.35                             |     |
| 2020-020100   |                       |                    | 10                    | 24,000  | 2,000              | 0.025                           | 0.4                              | 24,000                               | 1,700              | 0.025                           | 0.4                              | 17,700                                       | 770                | 0.01                            | 0.3                              |     |
| 2020-050040   |                       | R0.5               | 4                     | 24,000  | 2,000              | 0.1                             | 0.4                              | 24,000                               | 1,700              | 0.1                             | 0.4                              | 20,000                                       | 1,000              | 0.01                            | 0.4                              |     |
| 2020-050060   |                       |                    | 6                     | 24,000  | 2,000              | 0.1                             | 0.4                              | 24,000                               | 1,700              | 0.1                             | 0.4                              | 20,000                                       | 1,000              | 0.01                            | 0.4                              |     |
| 2020-050080   |                       |                    | 8                     | 24,000  | 2,000              | 0.075                           | 0.4                              | 24,000                               | 1,700              | 0.075                           | 0.4                              | 20,000                                       | 1,000              | 0.01                            | 0.35                             |     |
| 2020-050100   |                       |                    | 10                    | 24,000  | 2,000              | 0.05                            | 0.4                              | 24,000                               | 1,700              | 0.05                            | 0.4                              | 20,000                                       | 1,000              | 0.01                            | 0.3                              |     |
| 2030-005060   |                       | 3                  | R0.05                 | 6   | 20,000             | 1,500                           | 0.02                             | 0.6                                  | 20,000             | 1,300                           | 0.02                             | 0.6  | 13,500             | 600                             | 0.015                            | 0.6 |
| 2030-010060   |                       |                    | R0.1                  | 6   | 20,000             | 2,000                           | 0.04                             | 0.6                                  | 20,000             | 1,700                           | 0.04                             | 0.6  | 14,000             | 700                             | 0.02                             | 0.6 |
| 2030-020060   |                       |                    | R0.2                  | 6   | 20,000             | 2,000                           | 0.06                             | 0.6                                  | 20,000             | 1,700                           | 0.06                             | 0.6  | 14,500             | 770                             | 0.02                             | 0.6 |
| 2030-050060   |                       |                    | R0.5                  | 6   | 20,000             | 2,000                           | 0.12                             | 0.6                                  | 20,000             | 1,700                           | 0.12                             | 0.6  | 16,500             | 1,000                           | 0.02                             | 0.6 |

## Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Recommend oil mist to avoid tool damage.



Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.1 \sim \phi 2$

# CBN-LRF4000

NEW



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

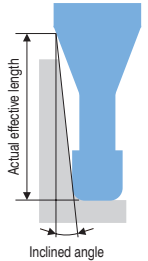
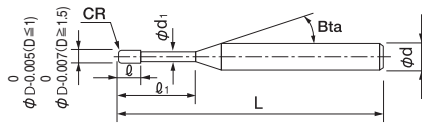
| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 | ○                                | ●               | ●      | ●      | ●      | ●      |           |                 |          |        |          |                       |                 |                       |                  |                                       |

Label Sample



#001  $\phi D1.999 R+0.001/0.000$

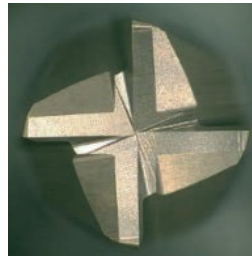
Diameter and Corner R accuracy measurements are printed on the label to support High Precision milling.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

## Features

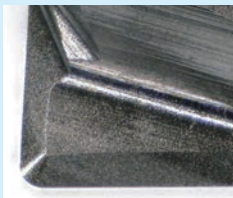
4-flute shape withstands high efficiency milling.  
Milling time can be significantly reduced compared to 2-flute.



## CBN-LRF2000/4000 Common features

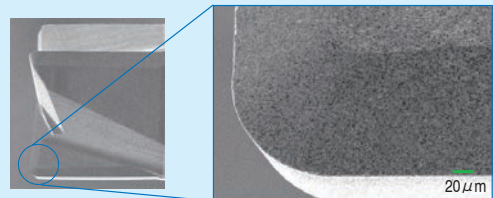
**Feature 1** High rigidity cutting edge

Super negative rake angle from the cutting edge at the tip point to peripheral cutting edge.  
Less damage when milling hard materials.



**Feature 2** Sharp cutting edge

The cutting edge is outstandingly sharp even with the super negative rake angle.

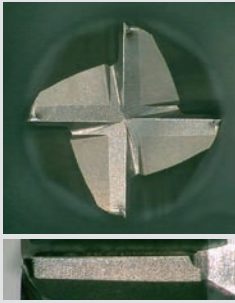
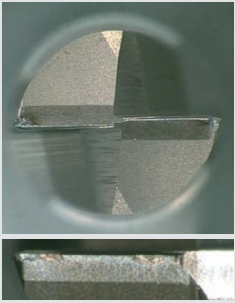
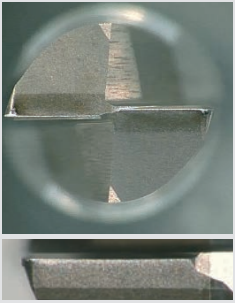




**Pocket milling**  
**2 Flutes / 4 Flutes CBN-LRF  $\phi 2 \times \text{CR}0.1 \times \text{EL}6$**

STAVAX (52HRC)

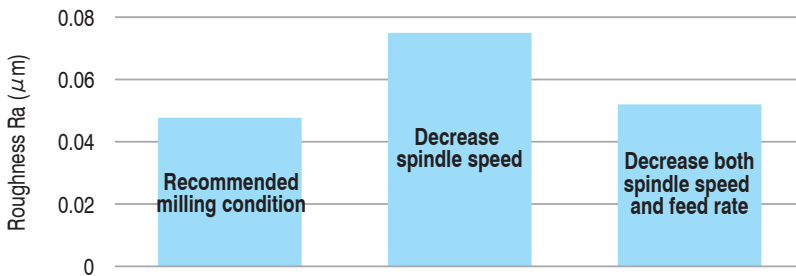
| Tool   | Flutes | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Feed per tooth (mm/t) | Cycle Time               |
|--|--------|------------------------------------|--------------------|------------|------------|-----------------------|--------------------------|
| CBN-LRF $\phi 2 \times \text{CR}0.1 \times \text{EL}6$ | 4      | 28,000                             | 3,300              | 0.05       | 0.7        | 0.029                 | 45 min / 1 pocket        |
| CBN-LRF $\phi 2 \times \text{CR}0.1 \times \text{EL}6$ | 2      | 28,000                             | 3,300              | 0.05       | 0.7        | 0.059                 | 45 min / 1 pocket        |
| CBN-LRF $\phi 2 \times \text{CR}0.1 \times \text{EL}6$ | 2      | 28,000                             | <b>1,650</b>       | 0.05       | 0.7        | 0.029                 | <b>85 min / 1 pocket</b> |

| Tool               | 4 Flutes   | 2 Flutes  | 2 Flutes   |
|--------------------|--|---|--|
| Feed rate (mm/min) | 3,300  | 3,300   | 1,650  |
| Cycle time         | 135 min  | 135 min   | 255 min  |
| Tool photo         |     |  |                      |
| Milling results    | Mill under higher efficiency conditions than 2-flute. Greatly shortens milling time. | Large damage under the same milling conditions as 4-flute.                        | When the feed per tooth is the same, the damage is small, but the milling time is about twice as long. |

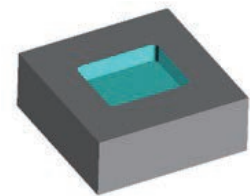
Pocket Size: 50 × 40 × 2 mm Coolant: Oil mist

**Surface roughness by different milling conditions**  
**4 Flutes CBN-LRF  $\phi 0.3 \times \text{CR}0.05 \times \text{EL}0.5$**

STAVAX (52HRC)



|                                    |                 |                 |                 |
|------------------------------------|-----------------|-----------------|-----------------|
| Spindle speed (min <sup>-1</sup> ) | 60,000          | 30,000          | 30,000          |
| Feed rate (mm/min)                 | 950             | 950             | 475             |
| Cycle Time                         | 26 min / Pocket | 26 min / Pocket | 50 min / Pocket |



Pocket Size  
 10 × 4 × 0.2 mm  
 Coolant: Oil mist  
 $a_p$  : 0.005 mm  
 $a_e$  : 0.08 mm

**Achieves high-speed milling that exceeds conventional CBN end mills even for small diameters.**  
 $\phi 0.3$  can be used in a machining center equipped with a 30,000 min<sup>-1</sup> spindle. It is recommended to decrease both spindle speed and feed rate proportionally.

4 Flutes

$\phi 3$ mm Shank  
 V Series

UDC-PCD  
 Series

CBN  
 Series

Square

Square  
 Long Neck  
 Square

Radius

Radius  
 Long Neck  
 Radius

Radius

Radius  
 Taper Neck  
 Radius

Ball

Ball / Long  
 Shank Ball  
 Long Neck  
 Ball

Taper

Taper Neck  
 Ball  
 Taper

Barrel

Spiral  
 V Cutter

Drill

Technical Data

# 4 Flutes CBN Long Neck Radius End Mills

Total 62 models

\*Shank taper angle Bta is only for reference.

Unit (mm)

| Model Number        | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |      |       |      |      |
|---------------------|---------------------------|------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|------|-------|------|------|
|                     |                           |                  |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°   | 1°30' | 2°   | 3°   |
| CBN-LRF 4001-002002 | 0.1                       | RO.02            | 0.2                    | 0.04              | 0.09                     | 15°                   | 50               | 4                       | 49,200                   | 0.22                                | 0.23 | 0.25  | 0.26 | 0.28 |
| CBN-LRF 4001-002003 |                           |                  | 0.3                    |                   |                          |                       |                  |                         |                          | 0.33                                | 0.34 | 0.36  | 0.37 | 0.40 |
| CBN-LRF 4001-002005 |                           |                  | 0.5                    |                   |                          |                       |                  |                         |                          | 0.54                                | 0.56 | 0.58  | 0.60 | 0.65 |
| CBN-LRF 40015-002X2 | 0.15                      | RO.02            | 0.2                    | 0.06              | 0.14                     | 15°                   | 50               | 4                       | 49,200                   | 0.22                                | 0.23 | 0.25  | 0.26 | 0.28 |
| CBN-LRF 40015-002X3 |                           |                  | 0.3                    |                   |                          |                       |                  |                         |                          | 0.33                                | 0.34 | 0.36  | 0.37 | 0.40 |
| CBN-LRF 40015-002X5 |                           |                  | 0.5                    |                   |                          |                       |                  |                         |                          | 0.54                                | 0.56 | 0.58  | 0.60 | 0.65 |
| CBN-LRF 4002-002005 | 0.2                       | RO.02            | 0.5                    | 0.08              | 0.19                     | 15°                   | 50               | 4                       | 40,000                   | 0.54                                | 0.56 | 0.58  | 0.60 | 0.65 |
| CBN-LRF 4002-002X75 |                           |                  | 0.75                   |                   |                          |                       |                  |                         |                          | 0.80                                | 0.82 | 0.86  | 0.89 | 0.96 |
| CBN-LRF 4002-002010 |                           |                  | 1                      |                   |                          |                       |                  |                         |                          | 1.05                                | 1.09 | 1.13  | 1.18 | 1.27 |
| CBN-LRF 4002-005005 |                           | RO.05            | 0.5                    |                   |                          |                       |                  |                         |                          | 0.50                                | 0.55 | 0.60  | 0.65 |      |
| CBN-LRF 4002-005X75 |                           |                  | 0.75                   |                   |                          |                       |                  |                         |                          | 0.79                                | 0.82 | 0.85  | 0.88 | 0.96 |
| CBN-LRF 4002-005010 |                           |                  | 1                      |                   |                          |                       |                  |                         |                          | 1.05                                | 1.09 | 1.13  | 1.17 | 1.27 |
| CBN-LRF 4003-002X75 | 0.3                       | RO.02            | 0.75                   | 0.13              | 0.28                     | 15°                   | 50               | 4                       | 40,520                   | 0.83                                | 0.86 | 0.89  | 0.92 | 1.00 |
| CBN-LRF 4003-002010 |                           |                  | 1                      |                   |                          |                       |                  |                         |                          | 1.08                                | 1.12 | 1.17  | 1.21 | 1.31 |
| CBN-LRF 4003-005005 |                           | RO.05            | 0.5                    |                   |                          |                       |                  |                         |                          | 0.57                                | 0.59 | 0.61  | 0.63 | 0.68 |
| CBN-LRF 4004-002015 | 0.4                       | RO.02            | 1.5                    | 0.24              | 0.38                     | 15°                   | 50               | 4                       | 38,880                   | 1.54                                | 1.59 | 1.65  | 1.71 | 1.86 |
| CBN-LRF 4004-003005 |                           | RO.03            | 0.5                    |                   |                          |                       |                  |                         |                          | 0.51                                | 0.53 | 0.55  | 0.57 | 0.62 |
| CBN-LRF 4004-005005 |                           | RO.05            | 0.5                    |                   |                          |                       |                  |                         |                          | 0.51                                | 0.53 | 0.55  | 0.57 | 0.62 |
| CBN-LRF 4004-005015 |                           |                  | 1.5                    |                   |                          |                       |                  |                         |                          | 1.54                                | 1.59 | 1.65  | 1.71 | 1.85 |
| CBN-LRF 4004-010005 |                           | RO.1             | 0.5                    |                   |                          |                       |                  |                         |                          | 0.51                                | 0.53 | 0.54  | 0.56 | 0.61 |
| CBN-LRF 4004-010010 |                           |                  | 1                      |                   |                          |                       |                  |                         |                          | 0.51                                | 0.53 | 0.54  | 0.56 | 0.61 |
| CBN-LRF 4004-010010 |                           |                  | 1                      |                   |                          |                       |                  |                         |                          | 1.03                                | 1.06 | 1.10  | 1.14 | 1.23 |
| CBN-LRF 4005-002010 | 0.5                       | RO.02            | 1                      | 0.3               | 0.48                     | 15°                   | 50               | 4                       | 31,750                   | 1.03                                | 1.07 | 1.11  | 1.15 | 1.25 |
| CBN-LRF 4005-005005 |                           | RO.05            | 0.5                    |                   |                          |                       |                  |                         |                          | 0.51                                | 0.53 | 0.55  | 0.57 | 0.62 |
| CBN-LRF 4005-005010 |                           |                  | 1                      |                   |                          |                       |                  |                         |                          | 0.51                                | 0.53 | 0.55  | 0.57 | 0.62 |
| CBN-LRF 4005-005015 |                           |                  | 1.5                    |                   |                          |                       |                  |                         |                          | 1.54                                | 1.59 | 1.65  | 1.71 | 1.85 |
| CBN-LRF 4005-010005 |                           | RO.1             | 0.5                    |                   |                          |                       |                  |                         |                          | 0.51                                | 0.53 | 0.54  | 0.56 | 0.61 |
| CBN-LRF 4005-010015 |                           |                  | 1.5                    |                   |                          |                       |                  |                         |                          | 1.53                                | 1.59 | 1.64  | 1.70 | 1.84 |
| CBN-LRF 4005-015005 |                           | RO.15            | 0.5                    |                   |                          |                       |                  |                         |                          | 0.51                                | 0.52 | 0.54  | 0.56 | 0.59 |
| CBN-LRF 4005-015015 |                           |                  | 1.5                    |                   |                          |                       |                  |                         |                          | 1.53                                | 1.58 | 1.64  | 1.69 | 1.83 |
| CBN-LRF 4006-005005 |                           |                  | RO.05                  |                   |                          |                       |                  |                         |                          | 0.5                                 | 0.51 | 0.53  | 0.55 | 0.57 |
| CBN-LRF 4006-010005 |                           | RO.1             | 0.5                    |                   |                          |                       |                  |                         |                          | 0.3                                 | 0.58 | 15°   | 50   | 4    |
| CBN-LRF 4006-010010 | 1                         |                  | 0.51                   | 0.53              | 0.54                     | 0.56                  | 0.61             |                         |                          |                                     |      |       |      |      |
| CBN-LRF 4006-010010 | 1                         | 1.03             | 1.06                   | 1.10              | 1.14                     | 1.23                  |                  |                         |                          |                                     |      |       |      |      |

Next Page ➔



Unit (mm)

| Model Number        | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |        |       |      |      |      |      |
|---------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|--------|-------|------|------|------|------|
|                     |                           |                  |                           |                      |                          |                       |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°     | 3°    |      |      |      |      |
| CBN-LRF 4008-005010 | 0.8                       | RO.05            | 1                         | 0.56                 | 0.78                     | 15°                   | 50               | 4                       | 28,680                   | 1.03                                | 1.07  | 1.10  | 1.15   | 1.24  |      |      |      |      |
| CBN-LRF 4008-010010 |                           |                  | 1                         |                      |                          |                       | 50               | 4                       | 28,680                   | 1.03                                | 1.06  | 1.10  | 1.14   | 1.23  |      |      |      |      |
| CBN-LRF 4008-010020 |                           | RO.1             | 2                         |                      |                          |                       | 50               | 4                       | 28,680                   | 2.05                                | 2.12  | 2.20  | 2.28   | 2.46  |      |      |      |      |
| CBN-LRF 4008-010050 |                           |                  | 5                         |                      |                          |                       | 50               | 4                       | 32,520                   | 5.15                                | 5.33  | 5.52  | 5.73   | 6.19  |      |      |      |      |
| CBN-LRF 4008-020010 |                           | RO.2             | 1                         |                      |                          |                       | 50               | 4                       | 28,680                   | 1.02                                | 1.05  | 1.09  | 1.12   | 1.20  |      |      |      |      |
| CBN-LRF 4010-002010 | 1                         | RO.02            | 1                         | 0.7                  | 0.98                     | 15°                   | 50               | 4                       | 29,300                   | 1.03                                | 1.07  | 1.11  | 1.15   | 1.25  |      |      |      |      |
| CBN-LRF 4010-002030 |                           |                  | 3                         |                      |                          |                       | 50               | 4                       | 29,300                   | 3.10                                | 3.21  | 3.33  | 3.45   | 3.73  |      |      |      |      |
| CBN-LRF 4010-005010 |                           | RO.05            | 1                         |                      |                          |                       | 50               | 4                       | 26,420                   | 1.03                                | 1.07  | 1.11  | 1.15   | 1.24  |      |      |      |      |
| CBN-LRF 4010-005020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 26,420                   | 2.06                                | 2.14  | 2.21  | 2.30   | 2.48  |      |      |      |      |
| CBN-LRF 4010-010010 |                           | RO.1             | 1                         |                      |                          |                       | 50               | 4                       | 26,420                   | 1.03                                | 1.06  | 1.10  | 1.14   | 1.23  |      |      |      |      |
| CBN-LRF 4010-010020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 26,420                   | 2.06                                | 2.13  | 2.21  | 2.29   | 2.47  |      |      |      |      |
| CBN-LRF 4010-010030 |                           |                  | 3                         |                      |                          |                       | 50               | 4                       | 26,420                   | 3.10                                | 3.20  | 3.32  | 3.44   | 3.72  |      |      |      |      |
| CBN-LRF 4010-020020 |                           | RO.2             | 2                         |                      |                          |                       | 50               | 4                       | 26,420                   | 2.06                                | 2.13  | 2.20  | 2.28   | 2.45  |      |      |      |      |
| CBN-LRF 4015-002030 |                           | 1.5              | RO.02                     |                      |                          |                       | 3                | 1                       | 1.46                     | 15°                                 | 50    | 4     | 34,520 | 3.13  | 3.24 | 3.36 | 3.49 | 3.78 |
| CBN-LRF 4015-010030 |                           |                  | RO.1                      |                      |                          |                       | 3                |                         |                          |                                     | 50    | 4     | 31,080 | 3.13  | 3.24 | 3.35 | 3.48 | 3.76 |
| CBN-LRF 4015-030030 | RO.3                      |                  | 3                         | 50                   | 4                        | 31,080                | 3.12             |                         |                          |                                     | 3.23  | 3.33  | 3.45   | 3.71  |      |      |      |      |
| CBN-LRF 4015-050030 | RO.5                      |                  | 3                         | 50                   | 4                        | 31,080                | 3.12             |                         |                          |                                     | 3.21  | 3.31  | 3.42   | 3.66  |      |      |      |      |
| CBN-LRF 4020-002040 | 2                         | RO.02            | 4                         | 1.2                  | 1.97                     | 15°                   | 50               | 4                       | 35,630                   | 4.15                                | 4.29  | 4.45  | 4.62   | 5.00  |      |      |      |      |
| CBN-LRF 4020-002060 |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 35,630                   | 6.22                                | 6.43  | 6.67  | 6.92   | 7.48  |      |      |      |      |
| CBN-LRF 4020-002100 |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 38,650                   | 10.35                               | 10.71 | 11.10 | 11.52  | 12.46 |      |      |      |      |
| CBN-LRF 4020-005060 |                           | RO.05            | 6                         |                      |                          |                       | 50               | 4                       | 31,970                   | 6.21                                | 6.43  | 6.66  | 6.91   | 7.48  |      |      |      |      |
| CBN-LRF 4020-005100 |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 34,800                   | 10.35                               | 10.71 | 11.10 | 11.51  | 12.45 |      |      |      |      |
| CBN-LRF 4020-010040 |                           | RO.1             | 4                         |                      |                          |                       | 50               | 4                       | 31,970                   | 4.15                                | 4.29  | 4.44  | 4.61   | 4.98  |      |      |      |      |
| CBN-LRF 4020-010060 |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 31,970                   | 6.21                                | 6.43  | 6.66  | 6.91   | 7.46  |      |      |      |      |
| CBN-LRF 4020-010100 |                           | 10               | 50                        |                      |                          |                       | 4                | 34,800                  | 10.35                    | 10.71                               | 11.09 | 11.51 | 12.44  |       |      |      |      |      |
| CBN-LRF 4020-020040 |                           | RO.2             | 4                         |                      |                          |                       | 50               | 4                       | 31,970                   | 4.14                                | 4.28  | 4.43  | 4.59   | 4.95  |      |      |      |      |
| CBN-LRF 4020-020060 |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 31,970                   | 6.21                                | 6.42  | 6.65  | 6.89   | 7.44  |      |      |      |      |
| CBN-LRF 4020-020100 |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 34,800                   | 10.34                               | 10.70 | 11.08 | 11.49  | 12.41 |      |      |      |      |
| CBN-LRF 4020-050060 |                           | RO.5             | 6                         |                      |                          |                       | 50               | 4                       | 31,970                   | 6.20                                | 6.40  | 6.62  | 6.85   | 7.37  |      |      |      |      |
| CBN-LRF 4020-050100 |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 34,800                   | 10.33                               | 10.68 | 11.05 | 11.45  | 12.34 |      |      |      |      |

4 Flutes

3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square

Radius

Radius

Ball / Long  
Shank Ball

Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for CBN-LRF (4 Flutes)

| WORK MATERIAL |                       |                    |                       | HEAT-TREATED STEELS / HARDENED STEELS<br>STAVAX (~52HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11 (~62HRC)  |                    |                                 |                                  | HARDENED STEELS<br>HAP10 / HAP72 (~70HRC) |                    |                                 |                                  |
|---------------|-----------------------|--------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )        | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4001-002002   | 0.1                   | R0.02              | 0.2                   | 60,000   | 360                | 0.002                           | 0.02                             | 55,000                             | 280                | 0.002                           | 0.015                            | 50,000                                    | 200                | 0.002                           | 0.01                             |
| 4001-002003   |                       |                    | 0.3                   | 60,000   | 360                | 0.002                           | 0.02                             | 55,000                             | 280                | 0.002                           | 0.015                            | 50,000                                    | 200                | 0.002                           | 0.01                             |
| 4001-002005   |                       |                    | 0.5                   | 60,000   | 360                | 0.002                           | 0.02                             | 55,000                             | 280                | 0.002                           | 0.015                            | 50,000                                    | 200                | 0.002                           | 0.01                             |
| 40015-002X2   | 0.15                  | R0.02              | 0.2                   | 60,000   | 480                | 0.003                           | 0.03                             | 55,000                             | 340                | 0.003                           | 0.025                            | 50,000                                    | 250                | 0.002                           | 0.015                            |
| 40015-002X3   |                       |                    | 0.3                   | 60,000   | 480                | 0.003                           | 0.03                             | 55,000                             | 340                | 0.003                           | 0.025                            | 50,000                                    | 250                | 0.002                           | 0.015                            |
| 40015-002X5   |                       |                    | 0.5                   | 60,000   | 480                | 0.003                           | 0.03                             | 55,000                             | 340                | 0.003                           | 0.025                            | 50,000                                    | 250                | 0.002                           | 0.015                            |
| 4002-002005   | 0.2                   | R0.02              | 0.5                   | 60,000   | 560                | 0.003                           | 0.04                             | 55,000                             | 430                | 0.003                           | 0.03                             | 50,000                                    | 300                | 0.003                           | 0.02                             |
| 4002-002X75   |                       |                    | 0.75                  | 60,000   | 560                | 0.003                           | 0.04                             | 55,000                             | 430                | 0.003                           | 0.03                             | 50,000                                    | 300                | 0.003                           | 0.02                             |
| 4002-002010   |                       |                    | 1                     | 60,000   | 560                | 0.003                           | 0.04                             | 55,000                             | 430                | 0.003                           | 0.03                             | 50,000                                    | 300                | 0.003                           | 0.02                             |
| 4002-005005   | 0.2                   | R0.05              | 0.5                   | 60,000   | 700                | 0.003                           | 0.04                             | 55,000                             | 550                | 0.003                           | 0.03                             | 50,000                                    | 410                | 0.003                           | 0.02                             |
| 4002-005X75   |                       |                    | 0.75                  | 60,000   | 700                | 0.003                           | 0.04                             | 55,000                             | 550                | 0.003                           | 0.03                             | 50,000                                    | 410                | 0.003                           | 0.02                             |
| 4002-005010   |                       |                    | 1                     | 60,000   | 700                | 0.003                           | 0.04                             | 55,000                             | 550                | 0.003                           | 0.03                             | 50,000                                    | 410                | 0.003                           | 0.02                             |
| 4003-002X75   | 0.3                   | R0.02              | 0.75                  | 60,000   | 750                | 0.003                           | 0.08                             | 55,000                             | 580                | 0.003                           | 0.06                             | 50,000                                    | 400                | 0.003                           | 0.03                             |
| 4003-002010   |                       |                    | 1                     | 60,000   | 750                | 0.003                           | 0.08                             | 55,000                             | 580                | 0.003                           | 0.06                             | 50,000                                    | 400                | 0.003                           | 0.03                             |
| 4003-005005   |                       |                    | R0.05                 | 0.5  | 60,000             | 950                             | 0.005                            | 0.08                               | 55,000             | 750                             | 0.005                            | 0.06                                      | 50,000             | 550                             | 0.004                            |
| 4004-002015   | 0.4                   | R0.02              | 1.5                   | 55,000   | 850                | 0.005                           | 0.1                              | 53,000                             | 700                | 0.005                           | 0.08                             | 50,000                                    | 550                | 0.004                           | 0.05                             |
| 4004-003005   |                       | R0.03              | 0.5                   | 55,000   | 1,000              | 0.006                           | 0.1                              | 53,000                             | 800                | 0.006                           | 0.08                             | 50,000                                    | 600                | 0.004                           | 0.05                             |
| 4004-005005   |                       | R0.05              | 0.5                   | 55,000   | 1,200              | 0.01                            | 0.1                              | 53,000                             | 1,000              | 0.01                            | 0.08                             | 50,000                                    | 730                | 0.007                           | 0.05                             |
| 4004-005015   | 1.5                   |                    | 55,000                | 1,200  | 0.01               | 0.1                             | 53,000                           | 1,000                              | 0.01               | 0.08                            | 50,000                           | 730                                       | 0.007              | 0.05                            |                                  |
| 4004-010005   | 0.4                   | R0.1               | 0.5                   | 55,000   | 1,500              | 0.01                            | 0.1                              | 53,000                             | 1,300              | 0.01                            | 0.08                             | 50,000                                    | 1,000              | 0.008                           | 0.05                             |
| 4004-010010   |                       |                    | 1                     | 55,000   | 1,500              | 0.01                            | 0.1                              | 53,000                             | 1,300              | 0.01                            | 0.08                             | 50,000                                    | 1,000              | 0.008                           | 0.05                             |
| 4005-002010   | 0.5                   | R0.02              | 1                     | 50,000   | 950                | 0.005                           | 0.15                             | 50,000                             | 900                | 0.005                           | 0.12                             | 50,000                                    | 700                | 0.005                           | 0.08                             |
| 4005-005005   |                       | R0.05              | 0.5                   | 50,000   | 1,500              | 0.01                            | 0.15                             | 50,000                             | 1,300              | 0.01                            | 0.12                             | 50,000                                    | 1,000              | 0.01                            | 0.08                             |
| 4005-005010   |                       |                    | 1                     | 50,000   | 1,500              | 0.01                            | 0.15                             | 50,000                             | 1,300              | 0.01                            | 0.12                             | 50,000                                    | 1,000              | 0.01                            | 0.08                             |
| 4005-005015   |                       |                    | 1.5                   | 50,000   | 1,500              | 0.01                            | 0.15                             | 50,000                             | 1,300              | 0.01                            | 0.12                             | 50,000                                    | 1,000              | 0.01                            | 0.08                             |
| 4005-010005   |                       | R0.1               | 0.5                   | 50,000   | 1,900              | 0.02                            | 0.15                             | 50,000                             | 1,700              | 0.02                            | 0.12                             | 50,000                                    | 1,400              | 0.01                            | 0.08                             |
| 4005-010015   |                       |                    | 1.5                   | 50,000   | 1,900              | 0.02                            | 0.15                             | 50,000                             | 1,700              | 0.02                            | 0.12                             | 50,000                                    | 1,400              | 0.01                            | 0.08                             |
| 4005-015005   |                       | R0.15              | 0.5                   | 50,000   | 2,200              | 0.03                            | 0.15                             | 50,000                             | 2,000              | 0.03                            | 0.12                             | 50,000                                    | 1,800              | 0.01                            | 0.08                             |
| 4005-015015   |                       |                    | 1.5                   | 50,000   | 2,200              | 0.03                            | 0.15                             | 50,000                             | 2,000              | 0.03                            | 0.12                             | 50,000                                    | 1,800              | 0.01                            | 0.08                             |
| 4006-005005   |                       | 0.6                | R0.05                 | 0.5  | 50,000             | 1,700                           | 0.01                             | 0.2                                | 50,000             | 1,500                           | 0.01                             | 0.15                                      | 50,000             | 1,200                           | 0.01                             |
| 4006-010005   | R0.1                  |                    | 0.5                   | 50,000   | 2,300              | 0.02                            | 0.2                              | 50,000                             | 2,000              | 0.02                            | 0.15                             | 50,000                                    | 1,700              | 0.012                           | 0.1                              |
| 4006-010010   |                       |                    | 1                     | 50,000   | 2,300              | 0.02                            | 0.2                              | 50,000                             | 2,000              | 0.02                            | 0.15                             | 50,000                                    | 1,700              | 0.012                           | 0.1                              |

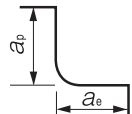
- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for CBN-LRF (4 Flutes)

| WORK MATERIAL |                       |                    |                       | HEAT-TREATED STEELS / HARDENED STEELS<br>STAVAX<br>(~52HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10 / HAP72<br>(~70HRC) |                    |                                 |                                  |     |
|---------------|-----------------------|--------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|--------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|-----|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )           | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |     |
| 4008-005010   | 0.8                   | R0.05              | 1                     | 45,000  | 1,800              | 0.01                            | 0.28                             | 44,000                               | 1,600              | 0.01                            | 0.21                             | 42,000                                       | 1,300              | 0.01                            | 0.13                             |     |
| 4008-010010   |                       | R0.1               | 1                     | 45,000  | 2,400              | 0.02                            | 0.28                             | 44,000                               | 2,000              | 0.02                            | 0.21                             | 42,000                                       | 1,600              | 0.015                           | 0.13                             |     |
| 4008-010020   |                       |                    | 2                     | 45,000  | 2,400              | 0.02                            | 0.28                             | 44,000                               | 2,000              | 0.02                            | 0.21                             | 42,000                                       | 1,600              | 0.015                           | 0.13                             |     |
| 4008-010050   |                       |                    | 5                     | 45,000  | 1,700              | 0.02                            | 0.14                             | 44,000                               | 1,400              | 0.02                            | 0.11                             | 42,000                                       | 1,100              | 0.015                           | 0.07                             |     |
| 4008-020010   |                       | R0.2               | 1                     | 45,000  | 2,400              | 0.04                            | 0.28                             | 44,000                               | 2,100              | 0.04                            | 0.21                             | 42,000                                       | 1,800              | 0.015                           | 0.13                             |     |
| 4010-002010   | 1                     | R0.02              | 1                     | 40,000  | 1,300              | 0.006                           | 0.35                             | 37,000                               | 1,100              | 0.006                           | 0.3                              | 34,000                                       | 900                | 0.005                           | 0.2                              |     |
| 4010-002030   |                       |                    | 3                     | 40,000  | 1,300              | 0.006                           | 0.35                             | 37,000                               | 1,100              | 0.006                           | 0.3                              | 34,000                                       | 900                | 0.005                           | 0.2                              |     |
| 4010-005010   |                       | R0.05              | 1                     | 40,000  | 1,900              | 0.015                           | 0.35                             | 37,000                               | 1,600              | 0.015                           | 0.3                              | 34,000                                       | 1,200              | 0.01                            | 0.2                              |     |
| 4010-005020   |                       |                    | 2                     | 40,000  | 1,900              | 0.015                           | 0.35                             | 37,000                               | 1,600              | 0.015                           | 0.3                              | 34,000                                       | 1,200              | 0.01                            | 0.2                              |     |
| 4010-010010   |                       | R0.1               | 1                     | 40,000  | 2,600              | 0.03                            | 0.35                             | 37,000                               | 2,000              | 0.03                            | 0.3                              | 34,000                                       | 1,400              | 0.015                           | 0.2                              |     |
| 4010-010020   |                       |                    | 2                     | 40,000  | 2,600              | 0.03                            | 0.35                             | 37,000                               | 2,000              | 0.03                            | 0.3                              | 34,000                                       | 1,400              | 0.015                           | 0.2                              |     |
| 4010-010030   |                       |                    | 3                     | 40,000  | 2,600              | 0.03                            | 0.35                             | 37,000                               | 2,000              | 0.03                            | 0.3                              | 34,000                                       | 1,400              | 0.015                           | 0.2                              |     |
| 4010-020020   |                       | R0.2               | 2                     | 40,000  | 2,600              | 0.05                            | 0.35                             | 37,000                               | 2,200              | 0.05                            | 0.3                              | 34,000                                       | 1,800              | 0.015                           | 0.2                              |     |
| 4015-002030   |                       | 1.5                | R0.02                 | 3   | 30,000             | 1,500                           | 0.01                             | 0.55                                 | 27,000             | 1,300                           | 0.01                             | 0.5  | 23,000             | 1,100                           | 0.005                            | 0.3 |
| 4015-010030   |                       |                    | R0.1                  | 3   | 30,000             | 3,000                           | 0.05                             | 0.55                                 | 27,000             | 2,200                           | 0.05                             | 0.5  | 23,000             | 1,400                           | 0.02                             | 0.3 |
| 4015-030030   | R0.3                  |                    | 3                     | 30,000  | 3,000              | 0.07                            | 0.55                             | 27,000                               | 2,400              | 0.07                            | 0.5                              | 23,000                                       | 1,700              | 0.02                            | 0.3                              |     |
| 4015-050030   | R0.5                  |                    | 3                     | 30,000  | 3,000              | 0.1                             | 0.45                             | 27,000                               | 2,500              | 0.1                             | 0.4                              | 23,000                                       | 2,000              | 0.02                            | 0.3                              |     |
| 4020-002040   | 2                     | R0.02              | 4                     | 28,000  | 1,700              | 0.01                            | 0.7                              | 23,000                               | 1,500              | 0.01                            | 0.6                              | 18,000                                       | 1,200              | 0.005                           | 0.4                              |     |
| 4020-002060   |                       |                    | 6                     | 28,000  | 1,700              | 0.01                            | 0.7                              | 23,000                               | 1,500              | 0.01                            | 0.6                              | 18,000                                       | 1,200              | 0.005                           | 0.4                              |     |
| 4020-002100   |                       |                    | 10                    | 28,000  | 1,700              | 0.01                            | 0.7                              | 23,000                               | 1,500              | 0.01                            | 0.6                              | 18,000                                       | 1,200              | 0.005                           | 0.4                              |     |
| 4020-005060   |                       | R0.05              | 6                     | 28,000  | 2,500              | 0.025                           | 0.7                              | 23,000                               | 1,900              | 0.025                           | 0.6                              | 18,000                                       | 1,300              | 0.015                           | 0.4                              |     |
| 4020-005100   |                       |                    | 10                    | 28,000  | 2,500              | 0.025                           | 0.7                              | 23,000                               | 1,900              | 0.025                           | 0.6                              | 18,000                                       | 1,300              | 0.015                           | 0.4                              |     |
| 4020-010040   |                       | R0.1               | 4                     | 28,000  | 3,300              | 0.05                            | 0.7                              | 23,000                               | 2,400              | 0.05                            | 0.6                              | 18,000                                       | 1,500              | 0.03                            | 0.4                              |     |
| 4020-010060   |                       |                    | 6                     | 28,000  | 3,300              | 0.05                            | 0.7                              | 23,000                               | 2,400              | 0.05                            | 0.6                              | 18,000                                       | 1,500              | 0.03                            | 0.4                              |     |
| 4020-010100   |                       |                    | 10                    | 28,000  | 3,300              | 0.05                            | 0.7                              | 23,000                               | 2,400              | 0.05                            | 0.6                              | 18,000                                       | 1,500              | 0.03                            | 0.4                              |     |
| 4020-020040   |                       | R0.2               | 4                     | 28,000  | 3,300              | 0.07                            | 0.7                              | 23,000                               | 2,500              | 0.07                            | 0.6                              | 18,000                                       | 1,600              | 0.03                            | 0.4                              |     |
| 4020-020060   |                       |                    | 6                     | 28,000  | 3,300              | 0.07                            | 0.7                              | 23,000                               | 2,500              | 0.07                            | 0.6                              | 18,000                                       | 1,600              | 0.03                            | 0.4                              |     |
| 4020-020100   |                       | R0.5               | 10                    | 28,000  | 3,300              | 0.07                            | 0.7                              | 23,000                               | 2,500              | 0.07                            | 0.6                              | 18,000                                       | 1,600              | 0.03                            | 0.4                              |     |
| 4020-050060   |                       |                    | 6                     | 28,000  | 3,300              | 0.1                             | 0.7                              | 23,000                               | 2,600              | 0.1                             | 0.6                              | 18,000                                       | 1,800              | 0.03                            | 0.4                              |     |
| 4020-050100   |                       |                    | 10                    | 28,000  | 3,300              | 0.1                             | 0.7                              | 23,000                               | 2,600              | 0.1                             | 0.6                              | 18,000                                       | 1,800              | 0.03                            | 0.4                              |     |

**Note:**

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Recommend oil mist to avoid tool damage.



4 Flutes

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.1 \sim \phi 12$

**CSS**

Super MG

UT COAT

30°

40°

Flatland

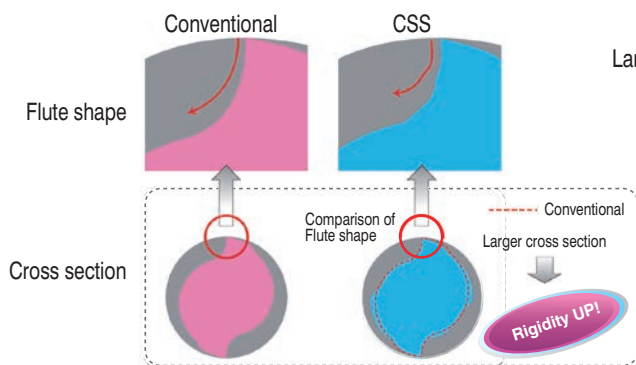
Shank Dia 0/-0.005

\*1 Helix angle 30°:  $\phi D < 0.6, 1 \leq \phi D$  (length of cut 2.5D~3D)  
 \*2 Helix angle 40°:  $0.6 \leq \phi D < 1, 1 \leq \phi D$  (length of cut 1D~2D)

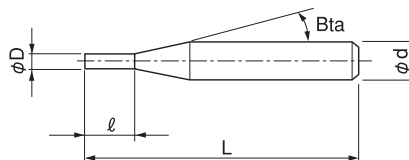
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        | ○         | ○               |          | ●      |          |                       | ○               | ○                     |                  |                                       |

### Unique Cross Section design



New flute shape → Higher rigidity and better chip evacuation  
 Larger cross section → More resistance to breakage and wearing



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 112 models

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|---------------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| CSS 2001-0010   | 0.1                       | 0.1                  | 16°                   | 45               | 4                       | 7,800                    |
| CSS 2001-0015   |                           | 0.15                 |                       | 45               | 4                       | 7,800                    |
| CSS 2001-0020   |                           | 0.2                  |                       | 45               | 4                       | 7,800                    |
| CSS 2001-0025   |                           | 0.25                 |                       | 45               | 4                       | 7,800                    |
| CSS 2001-0030   |                           | 0.3                  |                       | 45               | 4                       | 7,800                    |
| CSS 2002-0020   | 0.2                       | 0.2                  | 16°                   | 45               | 4                       | 4,680                    |
| CSS 2002-0030   |                           | 0.3                  |                       | 45               | 4                       | 4,680                    |
| CSS 2002-0040-3 |                           | 0.4                  |                       | 38               | 3                       | 4,680                    |
| CSS 2002-0040-4 |                           | 0.4                  |                       | 45               | 4                       | 4,680                    |
| CSS 2002-0050   |                           | 0.5                  |                       | 45               | 4                       | 4,680                    |
| CSS 2002-0060   | 0.6                       | 45                   | 4                     | 4,680            |                         |                          |
| CSS 2003-0030   | 0.3                       | 0.3                  | 16°                   | 45               | 4                       | 4,080                    |
| CSS 2003-0045   |                           | 0.45                 |                       | 45               | 4                       | 4,080                    |
| CSS 2003-0060-3 |                           | 0.6                  |                       | 38               | 3                       | 4,080                    |
| CSS 2003-0060-4 |                           | 0.6                  |                       | 45               | 4                       | 4,080                    |
| CSS 2003-0075   |                           | 0.75                 |                       | 45               | 4                       | 4,080                    |
| CSS 2003-0090   | 0.9                       | 45                   | 4                     | 4,080            |                         |                          |

Unit (mm)

| Model Number    | Outside Diameter<br>$\phi D$ | Length of Cut<br>$\ell$ | Shank Taper Angle<br>Bta | Overall Length<br>L | Shank Diameter<br>$\phi d$ | Suggested Retail Price<br>¥ |
|-----------------|------------------------------|-------------------------|--------------------------|---------------------|----------------------------|-----------------------------|
| CSS 2004-0040   | 0.4                          | 0.4                     | 16°                      | 45                  | 4                          | 4,560                       |
| CSS 2004-0060   |                              | 0.6                     |                          | 45                  | 4                          | 4,560                       |
| CSS 2004-0080-3 |                              | 0.8                     |                          | 38                  | 3                          | 4,560                       |
| CSS 2004-0080-4 |                              |                         |                          | 45                  | 4                          | 4,560                       |
| CSS 2004-0100   |                              | 1                       |                          | 45                  | 4                          | 4,560                       |
| CSS 2004-0120   |                              | 1.2                     |                          | 45                  | 4                          | 4,560                       |
| CSS 2005-0050   | 0.5                          | 0.5                     | 16°                      | 45                  | 4                          | 2,280                       |
| CSS 2005-0075   |                              | 0.75                    |                          | 45                  | 4                          | 2,280                       |
| CSS 2005-0080   |                              | 0.8                     |                          | 38                  | 3                          | 2,280                       |
| CSS 2005-0100   |                              | 1                       |                          | 45                  | 4                          | 2,280                       |
| CSS 2005-0125   |                              | 1.25                    |                          | 45                  | 4                          | 2,280                       |
| CSS 2005-0150   |                              | 1.5                     |                          | 45                  | 4                          | 2,280                       |
| CSS 2006-0060   | 0.6                          | 0.6                     | 16°                      | 45                  | 4                          | 3,480                       |
| CSS 2006-0090   |                              | 0.9                     |                          | 45                  | 4                          | 3,480                       |
| CSS 2006-0100   |                              | 1                       |                          | 38                  | 3                          | 3,480                       |
| CSS 2006-0120   |                              | 1.2                     |                          | 45                  | 4                          | 3,480                       |
| CSS 2006-0150   |                              | 1.5                     |                          | 45                  | 4                          | 3,480                       |
| CSS 2006-0180   |                              | 1.8                     |                          | 45                  | 4                          | 3,480                       |
| CSS 2007-0070   | 0.7                          | 0.7                     | 16°                      | 45                  | 4                          | 3,840                       |
| CSS 2007-0100   |                              | 1                       |                          | 38                  | 3                          | 3,840                       |
| CSS 2007-0140   |                              | 1.4                     |                          | 45                  | 4                          | 3,840                       |
| CSS 2007-0175   |                              | 1.75                    |                          | 45                  | 4                          | 3,840                       |
| CSS 2007-0210   |                              | 2.1                     |                          | 45                  | 4                          | 3,840                       |
| CSS 2008-0080   |                              | 0.8                     |                          | 0.8                 | 16°                        | 45                          |
| CSS 2008-0120-3 | 1.2                          |                         | 38                       | 3                   |                            | 2,280                       |
| CSS 2008-0120-4 |                              |                         | 45                       | 4                   |                            | 2,280                       |
| CSS 2008-0160   | 1.6                          |                         | 45                       | 4                   |                            | 2,280                       |
| CSS 2008-0200   | 2                            |                         | 45                       | 4                   |                            | 2,280                       |
| CSS 2008-0240   | 2.4                          |                         | 45                       | 4                   |                            | 2,280                       |
| CSS 2009-0090   | 0.9                          | 0.9                     | 16°                      | 45                  | 4                          | 3,840                       |
| CSS 2009-0120   |                              | 1.2                     |                          | 38                  | 3                          | 3,840                       |
| CSS 2009-0180   |                              | 1.8                     |                          | 45                  | 4                          | 3,840                       |
| CSS 2009-0225   |                              | 2.25                    |                          | 45                  | 4                          | 3,840                       |
| CSS 2009-0270   |                              | 2.7                     |                          | 45                  | 4                          | 3,840                       |
| CSS 2010-0100   |                              | 1                       |                          | 1                   | 16°                        | 45                          |
| CSS 2010-0150   | 1.5                          |                         | 45                       | 4                   |                            | 2,040                       |
| CSS 2010-0200   | 2                            |                         | 45                       | 4                   |                            | 2,040                       |
| CSS 2010-0250   | 2.5                          |                         | 45                       | 4                   |                            | 2,040                       |
| CSS 2010-0300   | 3                            |                         | 45                       | 4                   |                            | 2,040                       |
| CSS 2015-0150   | 1.5                          |                         | 1.5                      | 16°                 |                            | 45                          |
| CSS 2015-0225   |                              | 2.25                    | 45                       |                     | 4                          | 2,040                       |
| CSS 2015-0300   |                              | 3                       | 45                       |                     | 4                          | 2,040                       |
| CSS 2015-0375   |                              | 3.75                    | 45                       |                     | 4                          | 2,040                       |
| CSS 2015-0450   |                              | 4.5                     | 45                       |                     | 4                          | 2,040                       |
| CSS 2020-0200   |                              | 2                       | 2                        |                     | 16°                        | 45                          |
| CSS 2020-0300   | 3                            |                         | 45                       | 4                   |                            | 2,040                       |
| CSS 2020-0400   | 4                            |                         | 45                       | 4                   |                            | 2,040                       |
| CSS 2020-0500   | 5                            |                         | 45                       | 4                   |                            | 2,040                       |
| CSS 2020-0600   | 6                            |                         | 45                       | 4                   |                            | 2,040                       |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Unit (mm)

| Model Number  | Outside Diameter<br>φD | Length of Cut<br>ℓ | Shank Taper Angle<br>Bta | Overall Length<br>L | Shank Diameter<br>φd | Suggested<br>Retail Price<br>¥ |
|---------------|------------------------|--------------------|--------------------------|---------------------|----------------------|--------------------------------|
| CSS 2025-0250 | 2.5                    | 2.5                | 16°                      | 50                  | 4                    | 2,040                          |
| CSS 2025-0375 |                        | 3.75               |                          | 50                  | 4                    | 2,040                          |
| CSS 2025-0500 |                        | 5                  |                          | 50                  | 4                    | 2,040                          |
| CSS 2025-0625 |                        | 6.25               |                          | 50                  | 4                    | 2,040                          |
| CSS 2025-0750 |                        | 7.5                |                          | 50                  | 4                    | 2,040                          |
| CSS 2030-0300 | 3                      | 3                  | 16°                      | 50                  | 6                    | 2,640                          |
| CSS 2030-0450 |                        | 4.5                |                          | 50                  | 6                    | 2,640                          |
| CSS 2030-0600 |                        | 6                  |                          | 50                  | 6                    | 2,640                          |
| CSS 2030-0750 |                        | 7.5                |                          | 50                  | 6                    | 2,640                          |
| CSS 2030-0900 | 4                      | 9                  | 16°                      | 50                  | 6                    | 2,640                          |
| CSS 2040-0400 |                        | 4                  |                          | 50                  | 6                    | 2,880                          |
| CSS 2040-0600 |                        | 6                  |                          | 50                  | 6                    | 2,880                          |
| CSS 2040-0800 |                        | 8                  |                          | 50                  | 6                    | 2,880                          |
| CSS 2040-1000 |                        | 10                 |                          | 50                  | 6                    | 2,880                          |
| CSS 2040-1200 | 12                     | 50                 | 6                        | 2,880               |                      |                                |
| CSS 2050-0500 | 5                      | 5                  | 16°                      | 50                  | 6                    | 3,120                          |
| CSS 2050-0750 |                        | 7.5                |                          | 50                  | 6                    | 3,120                          |
| CSS 2050-1000 |                        | 10                 |                          | 50                  | 6                    | 3,120                          |
| CSS 2050-1250 |                        | 12.5               |                          | 60                  | 6                    | 3,120                          |
| CSS 2050-1500 |                        | 15                 |                          | 60                  | 6                    | 3,120                          |
| CSS 2060-0600 | 6                      | 6                  | —                        | 50                  | 6                    | 3,360                          |
| CSS 2060-0900 |                        | 9                  |                          | 50                  | 6                    | 3,360                          |
| CSS 2060-1200 |                        | 12                 |                          | 50                  | 6                    | 3,360                          |
| CSS 2060-1500 |                        | 15                 |                          | 60                  | 6                    | 3,360                          |
| CSS 2060-1800 |                        | 18                 |                          | 60                  | 6                    | 3,360                          |
| CSS 2070-1750 | 7                      | 17.5               | 16°                      | 70                  | 8                    | 8,700                          |
| CSS 2070-2100 |                        | 21                 |                          | 80                  | 8                    | 8,700                          |
| CSS 2080-0800 | 8                      | 8                  | —                        | 70                  | 8                    | 6,320                          |
| CSS 2080-1200 |                        | 12                 |                          | 70                  | 8                    | 6,320                          |
| CSS 2080-1600 |                        | 16                 |                          | 70                  | 8                    | 6,320                          |
| CSS 2080-2000 |                        | 20                 |                          | 70                  | 8                    | 6,320                          |
| CSS 2080-2400 |                        | 24                 |                          | 80                  | 8                    | 6,320                          |
| CSS 2090-2250 | 9                      | 22.5               | 16°                      | 80                  | 10                   | 12,420                         |
| CSS 2090-2700 |                        | 27                 |                          | 80                  | 10                   | 12,420                         |
| CSS 2100-1000 | 10                     | 10                 | —                        | 70                  | 10                   | 7,580                          |
| CSS 2100-1500 |                        | 15                 |                          | 70                  | 10                   | 7,580                          |
| CSS 2100-2000 |                        | 20                 |                          | 70                  | 10                   | 7,580                          |
| CSS 2100-2500 |                        | 25                 |                          | 80                  | 10                   | 7,580                          |
| CSS 2100-3000 |                        | 30                 |                          | 80                  | 10                   | 7,580                          |
| CSS 2110-2750 | 11                     | 27.5               | 16°                      | 80                  | 12                   | 17,160                         |
| CSS 2110-3300 |                        | 33                 |                          | 80                  | 12                   | 17,160                         |
| CSS 2120-1200 | 12                     | 12                 | —                        | 80                  | 12                   | 11,170                         |
| CSS 2120-1800 |                        | 18                 |                          | 80                  | 12                   | 11,170                         |
| CSS 2120-2400 |                        | 24                 |                          | 80                  | 12                   | 11,170                         |
| CSS 2120-3000 |                        | 30                 |                          | 80                  | 12                   | 11,170                         |
| CSS 2120-3600 |                        | 36                 |                          | 90                  | 12                   | 11,170                         |

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for CSS

## Slotting

◆ 1D flute length type L/D=1

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                     | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                     | STAINLESS STEELS<br>SUS304<br>* Use water soluble or oil coolant. |                    |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|--|--------------------|---------------------|---|--------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                                | Feed Rate (mm/min) | Milling Amount (mm) |
|               |                       |                    |   | Slotting           | a <sub>p</sub>      |  | Slotting           | a <sub>p</sub>      |   | Slotting           | a <sub>p</sub>      |
| 2001-0010     | 0.1                   | 0.1                | 30,000  | 30                 | 0.01                | 30,000   | 30                 | 0.01                | 30,000  | 30                 | 0.01                |
| 2002-0020     | 0.2                   | 0.2                | 30,000  | 85                 | 0.02                | 30,000   | 85                 | 0.02                | 30,000  | 60                 | 0.02                |
| 2003-0030     | 0.3                   | 0.3                | 30,000  | 110                | 0.03                | 30,000   | 110                | 0.03                | 30,000  | 110                | 0.03                |
| 2004-0040     | 0.4                   | 0.4                | 30,000  | 120                | 0.04                | 30,000   | 120                | 0.04                | 30,000  | 120                | 0.04                |
| 2005-0050     | 0.5                   | 0.5                | 27,000  | 120                | 0.05                | 24,000   | 105                | 0.05                | 24,000  | 120                | 0.05                |
| 2006-0060     | 0.6                   | 0.6                | 24,000  | 120                | 0.09                | 20,000   | 90                 | 0.09                | 20,000  | 120                | 0.09                |
| 2007-0070     | 0.7                   | 0.7                | 22,500  | 115                | 0.105               | 17,800   | 90                 | 0.105               | 17,800  | 120                | 0.105               |
| 2008-0080     | 0.8                   | 0.8                | 21,000  | 110                | 0.12                | 16,700   | 90                 | 0.12                | 16,700  | 120                | 0.12                |
| 2009-0090     | 0.9                   | 0.9                | 19,500  | 105                | 0.135               | 15,600   | 85                 | 0.135               | 15,600  | 120                | 0.135               |
| 2010-0100     | 1                     | 1                  | 18,000  | 100                | 1                   | 14,500   | 75                 | 1                   | 14,500  | 125                | 1                   |
| 2015-0150     | 1.5                   | 1.5                | 16,000  | 275                | 1.5                 | 13,000   | 200                | 1.5                 | 13,000  | 135                | 1.5                 |
| 2020-0200     | 2                     | 2                  | 12,000  | 275                | 2                   | 10,000   | 200                | 2                   | 10,000  | 135                | 2                   |
| 2025-0250     | 2.5                   | 2.5                | 10,200  | 375                | 2.5                 | 8,400  | 260                | 2.5                 | 8,400   | 140                | 2.5                 |
| 2030-0300     | 3                     | 3                  | 8,500   | 475                | 3                   | 6,800  | 325                | 3                   | 6,800   | 150                | 3                   |
| 2040-0400     | 4                     | 4                  | 7,200   | 475                | 4                   | 5,700  | 325                | 4                   | 5,700   | 175                | 4                   |
| 2050-0500     | 5                     | 5                  | 6,000   | 500                | 5                   | 4,800  | 350                | 5                   | 4,800   | 200                | 5                   |
| 2060-0600     | 6                     | 6                  | 5,000   | 500                | 6                   | 4,000  | 350                | 6                   | 4,000   | 200                | 6                   |
| 2080-0800     | 8                     | 8                  | 3,500   | 475                | 8                   | 2,700  | 350                | 8                   | 2,400   | 150                | 8                   |
| 2100-1000     | 10                    | 10                 | 2,300   | 450                | 10                  | 1,900  | 325                | 10                  | 1,400   | 100                | 10                  |
| 2120-1200     | 12                    | 12                 | 1,850   | 425                | 12                  | 1,550  | 300                | 12                  | 1,250   | 90                 | 12                  |

| WORK MATERIAL |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                     | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|---|--------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | Milling Amount (mm) |
|               |                       |                    |   | Slotting           | a <sub>p</sub>      |   | Slotting           | a <sub>p</sub>      |
| 2001-0010     | 0.1                   | 0.1                | 30,000  | 15                 | 0.01                | 24,000  | 10                 | 0.004               |
| 2002-0020     | 0.2                   | 0.2                | 30,000  | 30                 | 0.02                | 23,000  | 25                 | 0.008               |
| 2003-0030     | 0.3                   | 0.3                | 30,000  | 55                 | 0.03                | 20,000  | 25                 | 0.012               |
| 2004-0040     | 0.4                   | 0.4                | 30,000  | 60                 | 0.04                | 16,800  | 25                 | 0.016               |
| 2005-0050     | 0.5                   | 0.5                | 24,000  | 60                 | 0.05                | 14,400  | 30                 | 0.025               |
| 2006-0060     | 0.6                   | 0.6                | 20,000  | 60                 | 0.09                | 12,000  | 35                 | 0.03                |
| 2007-0070     | 0.7                   | 0.7                | 17,800  | 60                 | 0.105               | 10,000  | 35                 | 0.035               |
| 2008-0080     | 0.8                   | 0.8                | 16,700  | 60                 | 0.12                | 8,500   | 35                 | 0.04                |
| 2009-0090     | 0.9                   | 0.9                | 15,600  | 60                 | 0.135               | 7,300   | 35                 | 0.045               |
| 2010-0100     | 1                     | 1                  | 14,500  | 60                 | 1                   | 6,550   | 35                 | 0.2                 |
| 2015-0150     | 1.5                   | 1.5                | 12,000  | 160                | 1.5                 | 4,400   | 35                 | 0.3                 |
| 2020-0200     | 2                     | 2                  | 9,000   | 160                | 2                   | 3,300   | 35                 | 0.4                 |
| 2025-0250     | 2.5                   | 2.5                | 7,900   | 210                | 2.5                 | 2,750   | 35                 | 0.5                 |
| 2030-0300     | 3                     | 3                  | 6,800   | 260                | 3                   | 2,200   | 35                 | 0.6                 |
| 2040-0400     | 4                     | 4                  | 5,100   | 260                | 4                   | 1,650   | 40                 | 0.8                 |
| 2050-0500     | 5                     | 5                  | 4,050   | 260                | 5                   | 1,300   | 40                 | 1                   |
| 2060-0600     | 6                     | 6                  | 3,300   | 260                | 6                   | 1,100   | 40                 | 1.2                 |
| 2080-0800     | 8                     | 8                  | 2,300   | 235                | 8                   | 800   | 40                 | 1.6                 |
| 2100-1000     | 10                    | 10                 | 1,500   | 225                | 10                  | 690   | 40                 | 2                   |
| 2120-1200     | 12                    | 12                 | 1,200   | 210                | 12                  | 550   | 40                 | 2.4                 |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for CSS

◆ 1.5D flute length type  $1 < L/D \leq 1.5$

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                     | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                     | STAINLESS STEELS<br>SUS304<br>*Use water soluble or oil coolant. |                    |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|--|--------------------|---------------------|--|--------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                               | Feed Rate (mm/min) | Milling Amount (mm) |
|               |                       |                    |   | Slotting           | a <sub>p</sub>      |  | Slotting           | a <sub>p</sub>      |  | Slotting           | a <sub>p</sub>      |
| 2001-0015     | 0.1                   | 0.15               | 30,000  | 30                 | 0.01                | 30,000   | 30                 | 0.01                | 30,000   | 30                 | 0.01                |
| 2002-0030     | 0.2                   | 0.3                | 30,000  | 85                 | 0.02                | 30,000   | 85                 | 0.02                | 30,000   | 60                 | 0.02                |
| 2003-0045     | 0.3                   | 0.45               | 30,000  | 110                | 0.03                | 30,000   | 110                | 0.03                | 30,000   | 110                | 0.03                |
| 2004-0060     | 0.4                   | 0.6                | 30,000  | 120                | 0.04                | 30,000   | 120                | 0.04                | 30,000   | 120                | 0.04                |
| 2005-0075     | 0.5                   | 0.75               | 27,000  | 120                | 0.05                | 24,000   | 105                | 0.05                | 24,000   | 120                | 0.05                |
| 2006-0090     | 0.6                   | 0.9                | 24,000  | 120                | 0.09                | 20,000   | 90                 | 0.09                | 20,000   | 120                | 0.09                |
| 2007-0100     | 0.7                   | 1                  | 22,500  | 115                | 0.105               | 17,800   | 90                 | 0.105               | 17,800   | 120                | 0.105               |
| 2008-0120     | 0.8                   | 1.2                | 21,000  | 110                | 0.12                | 16,700   | 90                 | 0.12                | 16,700   | 120                | 0.12                |
| 2009-0120     | 0.9                   | 1.2                | 19,500  | 105                | 0.135               | 15,600   | 85                 | 0.135               | 15,600   | 120                | 0.135               |
| 2010-0150     | 1                     | 1.5                | 18,000  | 100                | 1                   | 14,500   | 75                 | 1                   | 14,500   | 125                | 1                   |
| 2015-0225     | 1.5                   | 2.25               | 16,000  | 275                | 1.5                 | 13,000   | 200                | 1.5                 | 13,000   | 135                | 1.5                 |
| 2020-0300     | 2                     | 3                  | 12,000  | 275                | 2                   | 10,000   | 200                | 2                   | 10,000   | 135                | 2                   |
| 2025-0375     | 2.5                   | 3.75               | 10,200  | 375                | 2.5                 | 8,400  | 260                | 2.5                 | 8,400  | 140                | 2.5                 |
| 2030-0450     | 3                     | 4.5                | 8,500   | 475                | 3                   | 6,800  | 325                | 3                   | 6,800  | 150                | 3                   |
| 2040-0600     | 4                     | 6                  | 7,200   | 475                | 4                   | 5,700  | 325                | 4                   | 5,700  | 175                | 4                   |
| 2050-0750     | 5                     | 7.5                | 6,000   | 500                | 5                   | 4,800  | 350                | 5                   | 4,800  | 200                | 5                   |
| 2060-0900     | 6                     | 9                  | 5,000   | 500                | 6                   | 4,000  | 350                | 6                   | 4,000  | 200                | 6                   |
| 2080-1200     | 8                     | 12                 | 3,500   | 475                | 8                   | 2,700  | 350                | 8                   | 2,400  | 150                | 8                   |
| 2100-1500     | 10                    | 15                 | 2,300   | 450                | 10                  | 1,900  | 325                | 10                  | 1,400  | 100                | 10                  |
| 2120-1800     | 12                    | 18                 | 1,850   | 425                | 12                  | 1,550  | 300                | 12                  | 1,250  | 90                 | 12                  |

| WORK MATERIAL |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                     | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|---|--------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | Milling Amount (mm) |
|               |                       |                    |   | Slotting           | a <sub>p</sub>      |   | Slotting           | a <sub>p</sub>      |
| 2001-0015     | 0.1                   | 0.15               | 30,000  | 15                 | 0.01                | 24,000  | 10                 | 0.004               |
| 2002-0030     | 0.2                   | 0.3                | 30,000  | 30                 | 0.02                | 23,000  | 25                 | 0.008               |
| 2003-0045     | 0.3                   | 0.45               | 30,000  | 55                 | 0.03                | 20,000  | 25                 | 0.012               |
| 2004-0060     | 0.4                   | 0.6                | 30,000  | 60                 | 0.04                | 16,800  | 25                 | 0.016               |
| 2005-0075     | 0.5                   | 0.75               | 24,000  | 60                 | 0.05                | 14,400  | 30                 | 0.025               |
| 2006-0090     | 0.6                   | 0.9                | 20,000  | 60                 | 0.09                | 12,000  | 35                 | 0.03                |
| 2007-0100     | 0.7                   | 1                  | 17,800  | 60                 | 0.105               | 10,000  | 35                 | 0.035               |
| 2008-0120     | 0.8                   | 1.2                | 16,700  | 60                 | 0.12                | 8,500   | 35                 | 0.04                |
| 2009-0120     | 0.9                   | 1.2                | 15,600  | 60                 | 0.135               | 7,300   | 35                 | 0.045               |
| 2010-0150     | 1                     | 1.5                | 14,500  | 60                 | 1                   | 6,550   | 35                 | 0.2                 |
| 2015-0225     | 1.5                   | 2.25               | 12,000  | 160                | 1.5                 | 4,400   | 35                 | 0.3                 |
| 2020-0300     | 2                     | 3                  | 9,000   | 160                | 2                   | 3,300   | 35                 | 0.4                 |
| 2025-0375     | 2.5                   | 3.75               | 7,900   | 210                | 2.5                 | 2,750   | 35                 | 0.5                 |
| 2030-0450     | 3                     | 4.5                | 6,800   | 260                | 3                   | 2,200   | 35                 | 0.6                 |
| 2040-0600     | 4                     | 6                  | 5,100   | 260                | 4                   | 1,650   | 40                 | 0.8                 |
| 2050-0750     | 5                     | 7.5                | 4,050   | 260                | 5                   | 1,300   | 40                 | 1                   |
| 2060-0900     | 6                     | 9                  | 3,300   | 260                | 6                   | 1,100   | 40                 | 1.2                 |
| 2080-1200     | 8                     | 12                 | 2,300   | 235                | 8                   | 800   | 40                 | 1.6                 |
| 2100-1500     | 10                    | 15                 | 1,500   | 225                | 10                  | 690   | 40                 | 2                   |
| 2120-1800     | 12                    | 18                 | 1,200   | 210                | 12                  | 550   | 40                 | 2.4                 |



## Milling Conditions for CSS

◆ 2D flute length type  $1.5 < L/D \leq 2$ 

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                     | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                     | STAINLESS STEELS<br>SUS304<br>* Use water soluble or oil coolant. |                    |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|--|--------------------|---------------------|---|--------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                                | Feed Rate (mm/min) | Milling Amount (mm) |
|               |                       |                    |   | Slotting           | $a_p$               |  | Slotting           | $a_p$               |   | Slotting           | $a_p$               |
| 2001-0020     | 0.1                   | 0.2                | 30,000  | 30                 | 0.01                | 30,000   | 30                 | 0.01                | 30,000  | 30                 | 0.01                |
| 2002-0040     | 0.2                   | 0.4                | 30,000  | 85                 | 0.02                | 30,000   | 85                 | 0.02                | 30,000  | 60                 | 0.02                |
| 2003-0060     | 0.3                   | 0.6                | 30,000  | 110                | 0.03                | 30,000   | 110                | 0.03                | 30,000  | 110                | 0.03                |
| 2004-0080     | 0.4                   | 0.8                | 30,000  | 120                | 0.04                | 30,000   | 120                | 0.04                | 30,000  | 120                | 0.04                |
| 2005-0080     | 0.5                   | 0.8                | 27,000  | 120                | 0.05                | 24,000   | 105                | 0.05                | 24,000  | 120                | 0.05                |
| 2005-0100     | 0.5                   | 1                  | 27,000  | 120                | 0.05                | 24,000   | 105                | 0.05                | 24,000  | 120                | 0.05                |
| 2006-0100     | 0.6                   | 1                  | 24,000  | 120                | 0.09                | 20,000   | 90                 | 0.09                | 20,000  | 120                | 0.09                |
| 2006-0120     | 0.6                   | 1.2                | 24,000  | 120                | 0.09                | 20,000   | 90                 | 0.09                | 20,000  | 120                | 0.09                |
| 2007-0140     | 0.7                   | 1.4                | 22,500  | 115                | 0.105               | 17,800   | 90                 | 0.105               | 17,800  | 120                | 0.105               |
| 2008-0160     | 0.8                   | 1.6                | 21,000  | 110                | 0.12                | 16,700   | 90                 | 0.12                | 16,700  | 120                | 0.12                |
| 2009-0180     | 0.9                   | 1.8                | 19,500  | 105                | 0.135               | 15,600   | 85                 | 0.135               | 15,600  | 120                | 0.135               |
| 2010-0200     | 1                     | 2                  | 18,000  | 100                | 0.8                 | 14,500   | 75                 | 0.8                 | 14,500  | 125                | 0.8                 |
| 2015-0300     | 1.5                   | 3                  | 16,000  | 275                | 1.2                 | 13,000   | 200                | 1.2                 | 13,000  | 135                | 1.2                 |
| 2020-0400     | 2                     | 4                  | 12,000  | 275                | 1.6                 | 10,000   | 200                | 1.6                 | 10,000  | 135                | 1.6                 |
| 2025-0500     | 2.5                   | 5                  | 10,200  | 375                | 2                   | 8,400  | 260                | 2                   | 8,400   | 140                | 2                   |
| 2030-0600     | 3                     | 6                  | 8,500   | 475                | 2.4                 | 6,800  | 325                | 2.4                 | 6,800   | 150                | 2.4                 |
| 2040-0800     | 4                     | 8                  | 7,200   | 475                | 3.2                 | 5,700  | 325                | 3.2                 | 5,700   | 175                | 3.2                 |
| 2050-1000     | 5                     | 10                 | 6,000   | 500                | 4                   | 4,800  | 350                | 4                   | 4,800   | 200                | 4                   |
| 2060-1200     | 6                     | 12                 | 5,000   | 500                | 4.8                 | 4,000  | 350                | 4.8                 | 4,000   | 200                | 4.8                 |
| 2080-1600     | 8                     | 16                 | 3,500   | 475                | 6.4                 | 2,700  | 350                | 6.4                 | 2,400   | 150                | 6.4                 |
| 2100-2000     | 10                    | 20                 | 2,300   | 450                | 8                   | 1,900  | 325                | 8                   | 1,400   | 100                | 8                   |
| 2120-2400     | 12                    | 24                 | 1,850   | 425                | 9.6                 | 1,550  | 300                | 9.6                 | 1,250   | 90                 | 9.6                 |

| WORK MATERIAL |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                     | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|---|--------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | Milling Amount (mm) |
|               |                       |                    |   | Slotting           | $a_p$               |   | Slotting           | $a_p$               |
| 2001-0020     | 0.1                   | 0.2                | 30,000  | 15                 | 0.01                | 24,000  | 10                 | 0.003               |
| 2002-0040     | 0.2                   | 0.4                | 30,000  | 30                 | 0.02                | 23,000  | 25                 | 0.008               |
| 2003-0060     | 0.3                   | 0.6                | 30,000  | 55                 | 0.03                | 20,000  | 25                 | 0.012               |
| 2004-0080     | 0.4                   | 0.8                | 30,000  | 60                 | 0.04                | 16,800  | 25                 | 0.016               |
| 2005-0080     | 0.5                   | 0.8                | 24,000  | 60                 | 0.05                | 14,400  | 30                 | 0.025               |
| 2005-0100     | 0.5                   | 1                  | 24,000  | 60                 | 0.05                | 14,400  | 30                 | 0.025               |
| 2006-0100     | 0.6                   | 1                  | 20,000  | 60                 | 0.09                | 12,000  | 35                 | 0.03                |
| 2006-0120     | 0.6                   | 1.2                | 20,000  | 60                 | 0.09                | 12,000  | 35                 | 0.03                |
| 2007-0140     | 0.7                   | 1.4                | 17,800  | 60                 | 0.105               | 10,000  | 35                 | 0.035               |
| 2008-0160     | 0.8                   | 1.6                | 16,700  | 60                 | 0.12                | 8,500   | 35                 | 0.04                |
| 2009-0180     | 0.9                   | 1.8                | 15,600  | 60                 | 0.135               | 7,300   | 35                 | 0.045               |
| 2010-0200     | 1                     | 2                  | 14,500  | 60                 | 0.8                 | 6,550   | 35                 | 0.15                |
| 2015-0300     | 1.5                   | 3                  | 12,000  | 160                | 1.2                 | 4,400   | 35                 | 0.225               |
| 2020-0400     | 2                     | 4                  | 9,000   | 160                | 1.6                 | 3,300   | 35                 | 0.3                 |
| 2025-0500     | 2.5                   | 5                  | 7,900   | 210                | 2                   | 2,750   | 35                 | 0.37                |
| 2030-0600     | 3                     | 6                  | 6,800   | 260                | 2.4                 | 2,200   | 35                 | 0.45                |
| 2040-0800     | 4                     | 8                  | 5,100   | 260                | 3.2                 | 1,650   | 40                 | 0.6                 |
| 2050-1000     | 5                     | 10                 | 4,050   | 260                | 4                   | 1,300   | 40                 | 0.75                |
| 2060-1200     | 6                     | 12                 | 3,300   | 260                | 4.8                 | 1,100   | 40                 | 0.9                 |
| 2080-1600     | 8                     | 16                 | 2,300   | 235                | 3.2                 | 800   | 40                 | 1.2                 |
| 2100-2000     | 10                    | 20                 | 1,500   | 225                | 4                   | 690   | 40                 | 1.5                 |
| 2120-2400     | 12                    | 24                 | 1,200   | 210                | 4.8                 | 550   | 40                 | 1.8                 |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for CSS

◆ 2.5D flute length type  $2 < L/D \leq 2.5$

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                     | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                     | STAINLESS STEELS<br>SUS304<br>* Use water soluble or oil coolant. |                    |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|--|--------------------|---------------------|---|--------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                                | Feed Rate (mm/min) | Milling Amount (mm) |
|               |                       |                    |   | Slotting           | $a_p$               |  | Slotting           | $a_p$               |   | Slotting           | $a_p$               |
| 2001-0025     | 0.1                   | 0.25               | 30,000  | 30                 | 0.007               | 30,000   | 30                 | 0.007               | 30,000  | 30                 | 0.007               |
| 2002-0050     | 0.2                   | 0.5                | 30,000  | 85                 | 0.014               | 30,000   | 85                 | 0.014               | 30,000  | 60                 | 0.014               |
| 2003-0075     | 0.3                   | 0.75               | 30,000  | 110                | 0.021               | 30,000   | 110                | 0.021               | 30,000  | 110                | 0.021               |
| 2004-0100     | 0.4                   | 1                  | 30,000  | 120                | 0.028               | 30,000   | 120                | 0.028               | 30,000  | 120                | 0.028               |
| 2005-0125     | 0.5                   | 1.25               | 27,000  | 120                | 0.035               | 24,000   | 105                | 0.035               | 24,000  | 120                | 0.035               |
| 2006-0150     | 0.6                   | 1.5                | 24,000  | 120                | 0.06                | 20,000   | 90                 | 0.06                | 20,000  | 120                | 0.06                |
| 2007-0175     | 0.7                   | 1.75               | 22,500  | 115                | 0.07                | 17,800   | 90                 | 0.07                | 17,800  | 120                | 0.07                |
| 2008-0200     | 0.8                   | 2                  | 21,000  | 110                | 0.08                | 16,700   | 90                 | 0.08                | 16,700  | 120                | 0.08                |
| 2009-0225     | 0.9                   | 2.25               | 19,500  | 105                | 0.09                | 15,600   | 85                 | 0.09                | 15,600  | 120                | 0.09                |
| 2010-0250     | 1                     | 2.5                | 20,000  | 130                | 0.5                 | 15,000   | 60                 | 0.5                 | 11,000  | 120                | 0.25                |
| 2015-0375     | 1.5                   | 3.75               | 12,800  | 170                | 0.75                | 10,000   | 100                | 0.75                | 7,000   | 120                | 0.375               |
| 2020-0500     | 2                     | 5                  | 9,300   | 210                | 1                   | 7,500  | 140                | 1                   | 5,000   | 120                | 0.5                 |
| 2025-0625     | 2.5                   | 6.25               | 7,600   | 235                | 1.25                | 6,250  | 160                | 1.25                | 4,100   | 120                | 0.62                |
| 2030-0750     | 3                     | 7.5                | 5,900   | 260                | 1.5                 | 5,000  | 180                | 1.5                 | 3,200   | 120                | 0.75                |
| 2040-1000     | 4                     | 10                 | 4,200   | 300                | 2                   | 3,750  | 220                | 2                   | 2,250   | 120                | 1                   |
| 2050-1250     | 5                     | 12.5               | 3,200   | 340                | 2.5                 | 3,000  | 260                | 2.5                 | 1,700   | 120                | 1.25                |
| 2060-1500     | 6                     | 15                 | 2,500   | 380                | 3                   | 2,500  | 300                | 3                   | 1,350   | 120                | 1.5                 |
| 2070-1750     | 7                     | 17.5               | 2,270   | 345                | 3.5                 | 2,270  | 270                | 3.5                 | 1,150   | 105                | 1.75                |
| 2080-2000     | 8                     | 20                 | 2,100   | 320                | 4                   | 2,100  | 250                | 4                   | 1,000   | 90                 | 2                   |
| 2090-2250     | 9                     | 22.5               | 1,935   | 300                | 4.5                 | 1,935  | 220                | 4.5                 | 895   | 80                 | 2.25                |
| 2100-2500     | 10                    | 25                 | 1,800   | 280                | 5                   | 1,800  | 200                | 5                   | 810   | 75                 | 2.5                 |
| 2110-2750     | 11                    | 27.5               | 1,635   | 265                | 5.5                 | 1,635  | 180                | 5.5                 | 735   | 70                 | 2.75                |
| 2120-3000     | 12                    | 30                 | 1,500   | 250                | 6                   | 1,500  | 160                | 6                   | 670   | 65                 | 3                   |

| WORK MATERIAL |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                     | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|---|--------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | Milling Amount (mm) |
|               |                       |                    |   | Slotting           | $a_p$               |   | Slotting           | $a_p$               |
| 2001-0025     | 0.1                   | 0.25               | 30,000  | 15                 | 0.007               | 24,000  | 10                 | 0.002               |
| 2002-0050     | 0.2                   | 0.5                | 30,000  | 30                 | 0.014               | 23,000  | 25                 | 0.004               |
| 2003-0075     | 0.3                   | 0.75               | 30,000  | 55                 | 0.021               | 20,000  | 25                 | 0.006               |
| 2004-0100     | 0.4                   | 1                  | 30,000  | 60                 | 0.028               | 16,800  | 25                 | 0.008               |
| 2005-0125     | 0.5                   | 1.25               | 24,000  | 60                 | 0.035               | 14,400  | 30                 | 0.015               |
| 2006-0150     | 0.6                   | 1.5                | 20,000  | 60                 | 0.06                | 12,000  | 35                 | 0.018               |
| 2007-0175     | 0.7                   | 1.75               | 17,800  | 60                 | 0.07                | 10,000  | 35                 | 0.021               |
| 2008-0200     | 0.8                   | 2                  | 16,700  | 60                 | 0.08                | 8,500   | 35                 | 0.024               |
| 2009-0225     | 0.9                   | 2.25               | 15,600  | 60                 | 0.09                | 7,300   | 35                 | 0.027               |
| 2010-0250     | 1                     | 2.5                | 11,000  | 60                 | 0.25                | 5,500   | 20                 | 0.05                |
| 2015-0375     | 1.5                   | 3.75               | 7,500   | 90                 | 0.375               | 3,750   | 25                 | 0.075               |
| 2020-0500     | 2                     | 5                  | 5,700   | 120                | 0.5                 | 2,850   | 30                 | 0.1                 |
| 2025-0625     | 2.5                   | 6.25               | 4,800   | 135                | 0.62                | 2,400   | 30                 | 0.12                |
| 2030-0750     | 3                     | 7.5                | 3,900   | 150                | 0.75                | 1,950   | 35                 | 0.15                |
| 2040-1000     | 4                     | 10                 | 2,900   | 180                | 1                   | 1,450   | 40                 | 0.2                 |
| 2050-1250     | 5                     | 12.5               | 2,400   | 210                | 1.25                | 1,200   | 45                 | 0.25                |
| 2060-1500     | 6                     | 15                 | 2,000   | 240                | 1.5                 | 1,000   | 55                 | 0.3                 |
| 2070-1750     | 7                     | 17.5               | 1,630   | 230                | 1.5                 | 815   | 55                 | 0.3                 |
| 2080-2000     | 8                     | 20                 | 1,350   | 220                | 1.5                 | 675   | 55                 | 0.3                 |
| 2090-2250     | 9                     | 22.5               | 1,135   | 210                | 1.5                 | 565   | 55                 | 0.3                 |
| 2100-2500     | 10                    | 25                 | 960   | 200                | 1.5                 | 480   | 55                 | 0.3                 |
| 2110-2750     | 11                    | 27.5               | 845   | 180                | 1.5                 | 425   | 55                 | 0.3                 |
| 2120-3000     | 12                    | 30                 | 750   | 160                | 1.5                 | 375   | 55                 | 0.3                 |

## Milling Conditions for CSS

## ◆ 3D flute length type L/D=3

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                     | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                     | STAINLESS STEELS<br>SUS304<br>* Use water soluble or oil coolant. |                    |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|--|--------------------|---------------------|---|--------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                                | Feed Rate (mm/min) | Milling Amount (mm) |
|               |                       |                    |   | Slotting           | $a_p$               |  | Slotting           | $a_p$               |   | Slotting           | $a_p$               |
| 2001-0030     | 0.1                   | 0.3                | 30,000  | 30                 | 0.005               | 30,000   | 30                 | 0.005               | 30,000  | 30                 | 0.005               |
| 2002-0060     | 0.2                   | 0.6                | 30,000  | 85                 | 0.01                | 30,000   | 85                 | 0.01                | 30,000  | 60                 | 0.01                |
| 2003-0090     | 0.3                   | 0.9                | 30,000  | 110                | 0.015               | 30,000   | 110                | 0.015               | 30,000  | 110                | 0.015               |
| 2004-0120     | 0.4                   | 1.2                | 30,000  | 120                | 0.02                | 30,000   | 120                | 0.02                | 30,000  | 120                | 0.02                |
| 2005-0150     | 0.5                   | 1.5                | 27,000  | 120                | 0.025               | 24,000   | 105                | 0.025               | 24,000  | 120                | 0.025               |
| 2006-0180     | 0.6                   | 1.8                | 24,000  | 120                | 0.05                | 20,000   | 90                 | 0.05                | 20,000  | 120                | 0.05                |
| 2007-0210     | 0.7                   | 2.1                | 22,500  | 115                | 0.056               | 17,800   | 90                 | 0.056               | 17,800  | 120                | 0.056               |
| 2008-0240     | 0.8                   | 2.4                | 21,000  | 110                | 0.064               | 16,700   | 90                 | 0.064               | 16,700  | 120                | 0.064               |
| 2009-0270     | 0.9                   | 2.7                | 19,500  | 105                | 0.072               | 15,600   | 85                 | 0.072               | 15,600  | 120                | 0.072               |
| 2010-0300     | 1                     | 3                  | 20,000  | 130                | 0.5                 | 15,000   | 60                 | 0.5                 | 11,000  | 120                | 0.25                |
| 2015-0450     | 1.5                   | 4.5                | 12,800  | 170                | 0.75                | 10,000   | 100                | 0.75                | 7,000   | 120                | 0.375               |
| 2020-0600     | 2                     | 6                  | 9,300   | 210                | 1                   | 7,500  | 140                | 1                   | 5,000   | 120                | 0.5                 |
| 2025-0750     | 2.5                   | 7.5                | 7,600   | 235                | 1.25                | 6,250  | 160                | 1.25                | 4,100   | 120                | 0.62                |
| 2030-0900     | 3                     | 9                  | 5,900   | 260                | 1.5                 | 5,000  | 180                | 1.5                 | 3,200   | 120                | 0.75                |
| 2040-1200     | 4                     | 12                 | 4,200   | 300                | 2                   | 3,750  | 220                | 2                   | 2,250   | 120                | 1                   |
| 2050-1500     | 5                     | 15                 | 3,200   | 340                | 2.5                 | 3,000  | 260                | 2.5                 | 1,700   | 120                | 1.25                |
| 2060-1800     | 6                     | 18                 | 2,500   | 380                | 3                   | 2,500  | 300                | 3                   | 1,350   | 120                | 1.5                 |
| 2070-2100     | 7                     | 21                 | 2,270   | 345                | 3.5                 | 2,270  | 270                | 3.5                 | 1,150   | 105                | 1.75                |
| 2080-2400     | 8                     | 24                 | 2,100   | 320                | 4                   | 2,100  | 250                | 4                   | 1,000   | 90                 | 2                   |
| 2090-2700     | 9                     | 27                 | 1,935   | 300                | 4.5                 | 1,935  | 220                | 4.5                 | 895   | 80                 | 2.25                |
| 2100-3000     | 10                    | 30                 | 1,800   | 280                | 5                   | 1,800  | 200                | 5                   | 810   | 75                 | 2.5                 |
| 2110-3300     | 11                    | 33                 | 1,635   | 265                | 5.5                 | 1,635  | 180                | 5.5                 | 735   | 70                 | 2.75                |
| 2120-3600     | 12                    | 36                 | 1,500   | 250                | 6                   | 1,500  | 160                | 6                   | 670   | 65                 | 3                   |

| WORK MATERIAL |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                     | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|---|--------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | Milling Amount (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | Milling Amount (mm) |
|               |                       |                    |   | Slotting           | $a_p$               |   | Slotting           | $a_p$               |
| 2001-0030     | 0.1                   | 0.3                | 30,000  | 15                 | 0.005               | 24,000  | 10                 | 0.001               |
| 2002-0060     | 0.2                   | 0.6                | 30,000  | 30                 | 0.01                | 23,000  | 25                 | 0.002               |
| 2003-0090     | 0.3                   | 0.9                | 30,000  | 55                 | 0.015               | 20,000  | 25                 | 0.003               |
| 2004-0120     | 0.4                   | 1.2                | 30,000  | 60                 | 0.02                | 16,800  | 25                 | 0.004               |
| 2005-0150     | 0.5                   | 1.5                | 24,000  | 60                 | 0.025               | 14,400  | 30                 | 0.013               |
| 2006-0180     | 0.6                   | 1.8                | 20,000  | 60                 | 0.05                | 12,000  | 35                 | 0.015               |
| 2007-0210     | 0.7                   | 2.1                | 17,800  | 60                 | 0.056               | 10,000  | 35                 | 0.018               |
| 2008-0240     | 0.8                   | 2.4                | 16,700  | 60                 | 0.064               | 8,500   | 35                 | 0.02                |
| 2009-0270     | 0.9                   | 2.7                | 15,600  | 60                 | 0.072               | 7,300   | 35                 | 0.023               |
| 2010-0300     | 1                     | 3                  | 11,000  | 60                 | 0.25                | 5,500   | 15                 | 0.05                |
| 2015-0450     | 1.5                   | 4.5                | 7,500   | 90                 | 0.375               | 3,750   | 20                 | 0.075               |
| 2020-0600     | 2                     | 6                  | 5,700   | 120                | 0.5                 | 2,850   | 25                 | 0.1                 |
| 2025-0750     | 2.5                   | 7.5                | 4,800   | 135                | 0.62                | 2,400   | 30                 | 0.12                |
| 2030-0900     | 3                     | 9                  | 3,900   | 150                | 0.75                | 1,950   | 35                 | 0.15                |
| 2040-1200     | 4                     | 12                 | 2,900   | 180                | 1                   | 1,450   | 40                 | 0.2                 |
| 2050-1500     | 5                     | 15                 | 2,400   | 210                | 1.25                | 1,200   | 45                 | 0.25                |
| 2060-1800     | 6                     | 18                 | 2,000   | 240                | 1.5                 | 1,000   | 55                 | 0.3                 |
| 2070-2100     | 7                     | 21                 | 1,630   | 230                | 1.5                 | 815   | 55                 | 0.3                 |
| 2080-2400     | 8                     | 24                 | 1,350   | 220                | 1.5                 | 675   | 55                 | 0.3                 |
| 2090-2700     | 9                     | 27                 | 1,135   | 210                | 1.5                 | 565   | 55                 | 0.3                 |
| 2100-3000     | 10                    | 30                 | 960   | 200                | 1.5                 | 480   | 55                 | 0.3                 |
| 2110-3300     | 11                    | 33                 | 845   | 180                | 1.5                 | 425   | 55                 | 0.3                 |
| 2120-3600     | 12                    | 36                 | 750   | 160                | 1.5                 | 375   | 55                 | 0.3                 |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for CSS

### Side Milling

◆ 1D flute length type L/D=1

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                     |                | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                     |                | STAINLESS STEELS<br>SUS304<br>* Use water soluble or oil coolant. |                    |                     |                |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|----------------|--|--------------------|---------------------|----------------|---|--------------------|---------------------|----------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | Milling Amount (mm) |                | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | Milling Amount (mm) |                | Spindle Speed (min <sup>-1</sup> )                                | Feed Rate (mm/min) | Milling Amount (mm) |                |
|               |                       |                    |   | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |  | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |   | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |
| 2001-0010     | 0.1                   | 0.1                | 30,000  | 70                 | 0.1                 | 0.007          | 30,000   | 55                 | 0.1                 | 0.006          | 30,000  | 60                 | 0.1                 | 0.005          |
| 2002-0020     | 0.2                   | 0.2                | 30,000  | 180                | 0.2                 | 0.014          | 30,000   | 140                | 0.2                 | 0.012          | 30,000  | 120                | 0.2                 | 0.01           |
| 2003-0030     | 0.3                   | 0.3                | 30,000  | 280                | 0.3                 | 0.021          | 30,000   | 210                | 0.3                 | 0.018          | 30,000  | 180                | 0.3                 | 0.015          |
| 2004-0040     | 0.4                   | 0.4                | 30,000  | 380                | 0.4                 | 0.028          | 30,000   | 260                | 0.4                 | 0.024          | 30,000  | 225                | 0.4                 | 0.02           |
| 2005-0050     | 0.5                   | 0.5                | 27,000  | 490                | 0.5                 | 0.035          | 24,000   | 360                | 0.5                 | 0.03           | 24,000  | 315                | 0.5                 | 0.025          |
| 2006-0060     | 0.6                   | 0.6                | 24,000  | 600                | 0.6                 | 0.042          | 20,000   | 450                | 0.6                 | 0.036          | 20,000  | 400                | 0.6                 | 0.03           |
| 2007-0070     | 0.7                   | 0.7                | 22,500  | 600                | 0.7                 | 0.049          | 17,800   | 450                | 0.7                 | 0.042          | 17,800  | 400                | 0.7                 | 0.035          |
| 2008-0080     | 0.8                   | 0.8                | 21,000  | 600                | 0.8                 | 0.056          | 16,700   | 450                | 0.8                 | 0.048          | 16,700  | 400                | 0.8                 | 0.04           |
| 2009-0090     | 0.9                   | 0.9                | 19,500  | 600                | 0.9                 | 0.063          | 15,600   | 450                | 0.9                 | 0.054          | 15,600  | 400                | 0.9                 | 0.045          |
| 2010-0100     | 1                     | 1                  | 18,000  | 600                | 1                   | 0.075          | 14,500   | 450                | 1                   | 0.075          | 14,500  | 500                | 1                   | 0.05           |
| 2015-0150     | 1.5                   | 1.5                | 16,000  | 900                | 1.5                 | 0.113          | 13,000   | 600                | 1.5                 | 0.113          | 13,000  | 750                | 1.5                 | 0.075          |
| 2020-0200     | 2                     | 2                  | 12,000  | 900                | 2                   | 0.15           | 10,000   | 600                | 2                   | 0.15           | 10,000  | 750                | 2                   | 0.1            |
| 2025-0250     | 2.5                   | 2.5                | 10,200  | 900                | 2.5                 | 0.19           | 8,400  | 600                | 2.5                 | 0.19           | 8,400   | 750                | 2.5                 | 0.13           |
| 2030-0300     | 3                     | 3                  | 8,500   | 900                | 3                   | 0.225          | 6,800  | 600                | 3                   | 0.225          | 6,800   | 750                | 3                   | 0.15           |
| 2040-0400     | 4                     | 4                  | 7,200   | 675                | 4                   | 0.6            | 5,700  | 500                | 4                   | 0.6            | 5,700   | 575                | 4                   | 0.4            |
| 2050-0500     | 5                     | 5                  | 6,000   | 750                | 5                   | 0.75           | 4,800  | 550                | 5                   | 0.75           | 4,800   | 650                | 5                   | 0.5            |
| 2060-0600     | 6                     | 6                  | 5,000   | 800                | 6                   | 0.9            | 4,000  | 600                | 6                   | 0.9            | 4,000   | 650                | 6                   | 0.6            |
| 2080-0800     | 8                     | 8                  | 3,500   | 700                | 8                   | 1.2            | 2,700  | 525                | 8                   | 1.2            | 2,400   | 600                | 8                   | 0.8            |
| 2100-1000     | 10                    | 10                 | 2,300   | 600                | 10                  | 1.5            | 1,900  | 450                | 10                  | 1.5            | 1,400   | 500                | 10                  | 1              |
| 2120-1200     | 12                    | 12                 | 1,850   | 550                | 12                  | 1.8            | 1,550  | 400                | 12                  | 1.8            | 1,250   | 450                | 12                  | 1.2            |

| WORK MATERIAL |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                     |                | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                     |                |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|----------------|---|--------------------|---------------------|----------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | Milling Amount (mm) |                | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | Milling Amount (mm) |                |
|               |                       |                    |   | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |   | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |
| 2001-0010     | 0.1                   | 0.1                | 30,000  | 40                 | 0.1                 | 0.005          | 24,000  | 25                 | 0.1                 | 0.004          |
| 2002-0020     | 0.2                   | 0.2                | 30,000  | 80                 | 0.2                 | 0.01           | 23,000  | 35                 | 0.2                 | 0.008          |
| 2003-0030     | 0.3                   | 0.3                | 30,000  | 120                | 0.3                 | 0.015          | 20,000  | 45                 | 0.3                 | 0.012          |
| 2004-0040     | 0.4                   | 0.4                | 30,000  | 150                | 0.4                 | 0.02           | 16,800  | 55                 | 0.4                 | 0.016          |
| 2005-0050     | 0.5                   | 0.5                | 24,000  | 210                | 0.5                 | 0.025          | 14,400  | 65                 | 0.5                 | 0.02           |
| 2006-0060     | 0.6                   | 0.6                | 20,000  | 265                | 0.6                 | 0.03           | 12,000  | 80                 | 0.6                 | 0.024          |
| 2007-0070     | 0.7                   | 0.7                | 17,800  | 265                | 0.7                 | 0.035          | 10,000  | 80                 | 0.7                 | 0.028          |
| 2008-0080     | 0.8                   | 0.8                | 16,700  | 265                | 0.8                 | 0.04           | 8,500   | 80                 | 0.8                 | 0.032          |
| 2009-0090     | 0.9                   | 0.9                | 15,600  | 265                | 0.9                 | 0.045          | 7,300   | 80                 | 0.9                 | 0.036          |
| 2010-0100     | 1                     | 1                  | 14,500  | 300                | 1                   | 0.05           | 6,550   | 80                 | 1                   | 0.045          |
| 2015-0150     | 1.5                   | 1.5                | 12,000  | 450                | 1.5                 | 0.075          | 4,400   | 100                | 1.5                 | 0.068          |
| 2020-0200     | 2                     | 2                  | 9,000   | 450                | 2                   | 0.1            | 3,300   | 115                | 2                   | 0.09           |
| 2025-0250     | 2.5                   | 2.5                | 7,900   | 450                | 2.5                 | 0.13           | 2,750   | 120                | 2.5                 | 0.11           |
| 2030-0300     | 3                     | 3                  | 6,800   | 450                | 3                   | 0.15           | 2,200   | 130                | 3                   | 0.135          |
| 2040-0400     | 4                     | 4                  | 5,100   | 350                | 4                   | 0.4            | 1,650   | 150                | 4                   | 0.18           |
| 2050-0500     | 5                     | 5                  | 4,050   | 425                | 5                   | 0.5            | 1,300   | 160                | 5                   | 0.225          |
| 2060-0600     | 6                     | 6                  | 3,300   | 500                | 6                   | 0.6            | 1,100   | 180                | 6                   | 0.27           |
| 2080-0800     | 8                     | 8                  | 2,300   | 450                | 8                   | 0.8            | 800   | 130                | 8                   | 0.36           |
| 2100-1000     | 10                    | 10                 | 1,500   | 450                | 10                  | 1              | 690   | 110                | 10                  | 0.45           |
| 2120-1200     | 12                    | 12                 | 1,200   | 400                | 12                  | 1.2            | 550   | 110                | 12                  | 0.54           |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for CSS

◆ 1.5D flute length type  $1 < L/D \leq 1.5$ 

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                |                     | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                                    |                    |                | STAINLESS STEELS<br>SUS304<br>* Use water soluble or oil coolant. |                |                                    |                    |              |                     |                |
|---------------|-----------------------|--------------------|---|--------------------|----------------|---------------------|--|------------------------------------|--------------------|----------------|---|----------------|------------------------------------|--------------------|--------------|---------------------|----------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) |                | Milling Amount (mm) |  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) |                | Milling Amount (mm)   |                | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) |              | Milling Amount (mm) |                |
|               |                       |                    |   | Side Milling       | a <sub>p</sub> | a <sub>e</sub>      | Side Milling   |                                    | a <sub>p</sub>     | a <sub>e</sub> | Side Milling  | a <sub>p</sub> |                                    | a <sub>e</sub>     | Side Milling | a <sub>p</sub>      | a <sub>e</sub> |
| 2001-0015     | 0.1                   | 0.15               | 30,000  | 70                 | 0.15           | 0.007               | 30,000   | 55                                 | 0.15               | 0.006          | 30,000  | 60             | 0.15                               | 0.005              |              |                     |                |
| 2002-0030     | 0.2                   | 0.3                | 30,000  | 180                | 0.3            | 0.014               | 30,000   | 140                                | 0.3                | 0.012          | 30,000  | 120            | 0.3                                | 0.01               |              |                     |                |
| 2003-0045     | 0.3                   | 0.45               | 30,000  | 280                | 0.45           | 0.021               | 30,000   | 210                                | 0.45               | 0.018          | 30,000  | 180            | 0.45                               | 0.015              |              |                     |                |
| 2004-0060     | 0.4                   | 0.6                | 30,000  | 380                | 0.6            | 0.028               | 30,000   | 260                                | 0.6                | 0.024          | 30,000  | 225            | 0.6                                | 0.02               |              |                     |                |
| 2005-0075     | 0.5                   | 0.75               | 27,000  | 490                | 0.75           | 0.035               | 24,000   | 360                                | 0.75               | 0.03           | 24,000  | 315            | 0.75                               | 0.025              |              |                     |                |
| 2006-0090     | 0.6                   | 0.9                | 24,000  | 600                | 0.9            | 0.042               | 20,000   | 450                                | 0.9                | 0.036          | 20,000  | 400            | 0.9                                | 0.03               |              |                     |                |
| 2007-0100     | 0.7                   | 1                  | 22,500  | 600                | 1              | 0.049               | 17,800   | 450                                | 1                  | 0.042          | 17,800  | 400            | 1                                  | 0.035              |              |                     |                |
| 2008-0120     | 0.8                   | 1.2                | 21,000  | 600                | 1.2            | 0.056               | 16,700   | 450                                | 1.2                | 0.048          | 16,700  | 400            | 1.2                                | 0.04               |              |                     |                |
| 2009-0120     | 0.9                   | 1.2                | 19,500  | 600                | 1.2            | 0.063               | 15,600   | 450                                | 1.2                | 0.054          | 15,600  | 400            | 1.2                                | 0.045              |              |                     |                |
| 2010-0150     | 1                     | 1.5                | 18,000  | 600                | 1.5            | 0.075               | 14,500   | 450                                | 1.5                | 0.075          | 14,500  | 500            | 1.5                                | 0.05               |              |                     |                |
| 2015-0225     | 1.5                   | 2.25               | 16,000  | 900                | 2.25           | 0.113               | 13,000   | 600                                | 2.25               | 0.113          | 13,000  | 750            | 2.25                               | 0.075              |              |                     |                |
| 2020-0300     | 2                     | 3                  | 12,000  | 900                | 3              | 0.15                | 10,000   | 600                                | 3                  | 0.15           | 10,000  | 750            | 3                                  | 0.1                |              |                     |                |
| 2025-0375     | 2.5                   | 3.75               | 10,200  | 900                | 3.75           | 0.19                | 8,400  | 600                                | 3.75               | 0.19           | 8,400   | 750            | 3.75                               | 0.13               |              |                     |                |
| 2030-0450     | 3                     | 4.5                | 8,500   | 900                | 4.5            | 0.225               | 6,800  | 600                                | 4.5                | 0.225          | 6,800   | 750            | 4.5                                | 0.15               |              |                     |                |
| 2040-0600     | 4                     | 6                  | 7,200   | 675                | 6              | 0.6                 | 5,700  | 500                                | 6                  | 0.6            | 5,700   | 575            | 6                                  | 0.4                |              |                     |                |
| 2050-0750     | 5                     | 7.5                | 6,000   | 750                | 7.5            | 0.75                | 4,800  | 550                                | 7.5                | 0.75           | 4,800   | 650            | 7.5                                | 0.5                |              |                     |                |
| 2060-0900     | 6                     | 9                  | 5,000   | 800                | 9              | 0.9                 | 4,000  | 600                                | 9                  | 0.9            | 4,000   | 650            | 9                                  | 0.6                |              |                     |                |
| 2080-1200     | 8                     | 12                 | 3,500   | 700                | 12             | 1.2                 | 2,700  | 525                                | 12                 | 1.2            | 2,400   | 600            | 12                                 | 0.8                |              |                     |                |
| 2100-1500     | 10                    | 15                 | 2,300   | 600                | 15             | 1.5                 | 1,900  | 450                                | 15                 | 1.5            | 1,400   | 500            | 15                                 | 1                  |              |                     |                |
| 2120-1800     | 12                    | 18                 | 1,850   | 550                | 18             | 1.8                 | 1,550  | 400                                | 18                 | 1.8            | 1,250   | 450            | 18                                 | 1.2                |              |                     |                |

| WORK MATERIAL |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                |                     | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                                    |                    |                |                     |  |
|---------------|-----------------------|--------------------|---|--------------------|----------------|---------------------|---|------------------------------------|--------------------|----------------|---------------------|--|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) |                | Milling Amount (mm) |   | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) |                | Milling Amount (mm) |  |
|               |                       |                    |   | Side Milling       | a <sub>p</sub> | a <sub>e</sub>      | Side Milling  |                                    | a <sub>p</sub>     | a <sub>e</sub> |                     |  |
| 2001-0015     | 0.1                   | 0.15               | 30,000  | 40                 | 0.15           | 0.005               | 24,000  | 25                                 | 0.15               | 0.004          |                     |  |
| 2002-0030     | 0.2                   | 0.3                | 30,000  | 80                 | 0.3            | 0.01                | 23,000  | 35                                 | 0.3                | 0.008          |                     |  |
| 2003-0045     | 0.3                   | 0.45               | 30,000  | 120                | 0.45           | 0.015               | 20,000  | 45                                 | 0.45               | 0.012          |                     |  |
| 2004-0060     | 0.4                   | 0.6                | 30,000  | 150                | 0.6            | 0.02                | 16,800  | 55                                 | 0.6                | 0.016          |                     |  |
| 2005-0075     | 0.5                   | 0.75               | 24,000  | 210                | 0.75           | 0.025               | 14,400  | 65                                 | 0.75               | 0.02           |                     |  |
| 2006-0090     | 0.6                   | 0.9                | 20,000  | 265                | 0.9            | 0.03                | 12,000  | 80                                 | 0.9                | 0.024          |                     |  |
| 2007-0100     | 0.7                   | 1                  | 17,800  | 265                | 1              | 0.035               | 10,000  | 80                                 | 1                  | 0.028          |                     |  |
| 2008-0120     | 0.8                   | 1.2                | 16,700  | 265                | 1.2            | 0.04                | 8,500   | 80                                 | 1.2                | 0.032          |                     |  |
| 2009-0120     | 0.9                   | 1.2                | 15,600  | 265                | 1.2            | 0.045               | 7,300   | 80                                 | 1.2                | 0.036          |                     |  |
| 2010-0150     | 1                     | 1.5                | 14,500  | 300                | 1.5            | 0.05                | 6,550   | 80                                 | 1                  | 0.045          |                     |  |
| 2015-0225     | 1.5                   | 2.25               | 12,000  | 450                | 2.25           | 0.075               | 4,400   | 100                                | 1.5                | 0.068          |                     |  |
| 2020-0300     | 2                     | 3                  | 9,000   | 450                | 3              | 0.1                 | 3,300   | 115                                | 2                  | 0.09           |                     |  |
| 2025-0375     | 2.5                   | 3.75               | 7,900   | 450                | 3.75           | 0.13                | 2,750   | 120                                | 2.5                | 0.11           |                     |  |
| 2030-0450     | 3                     | 4.5                | 6,800   | 450                | 4.5            | 0.15                | 2,200   | 130                                | 3                  | 0.135          |                     |  |
| 2040-0600     | 4                     | 6                  | 5,100   | 350                | 6              | 0.4                 | 1,650   | 150                                | 4                  | 0.18           |                     |  |
| 2050-0750     | 5                     | 7.5                | 4,050   | 425                | 7.5            | 0.5                 | 1,300   | 160                                | 5                  | 0.225          |                     |  |
| 2060-0900     | 6                     | 9                  | 3,300   | 500                | 9              | 0.6                 | 1,100   | 180                                | 6                  | 0.27           |                     |  |
| 2080-1200     | 8                     | 12                 | 2,300   | 450                | 12             | 0.8                 | 800   | 130                                | 12                 | 0.36           |                     |  |
| 2100-1500     | 10                    | 15                 | 1,500   | 450                | 15             | 1                   | 690   | 110                                | 15                 | 0.45           |                     |  |
| 2120-1800     | 12                    | 18                 | 1,200   | 400                | 18             | 1.2                 | 550   | 110                                | 18                 | 0.54           |                     |  |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for CSS

◆ 2D flute length type  $1.5 < L/D \leq 2$

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                     |                | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                     |                | STAINLESS STEELS<br>SUS304<br>* Use water soluble or oil coolant. |                    |                     |                |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|----------------|--|--------------------|---------------------|----------------|---|--------------------|---------------------|----------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | Milling Amount (mm) |                | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | Milling Amount (mm) |                | Spindle Speed (min <sup>-1</sup> )                                | Feed Rate (mm/min) | Milling Amount (mm) |                |
|               |                       |                    |   | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |  | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |   | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |
| 2001-0020     | 0.1                   | 0.2                | 30,000  | 50                 | 0.15                | 0.006          | 30,000   | 50                 | 0.15                | 0.006          | 30,000  | 45                 | 0.15                | 0.005          |
| 2002-0040     | 0.2                   | 0.4                | 30,000  | 150                | 0.3                 | 0.012          | 30,000   | 140                | 0.3                 | 0.012          | 30,000  | 105                | 0.3                 | 0.01           |
| 2003-0060     | 0.3                   | 0.6                | 30,000  | 230                | 0.45                | 0.018          | 30,000   | 185                | 0.45                | 0.018          | 30,000  | 165                | 0.45                | 0.015          |
| 2004-0080     | 0.4                   | 0.8                | 30,000  | 315                | 0.6                 | 0.024          | 30,000   | 240                | 0.6                 | 0.02           | 30,000  | 225                | 0.6                 | 0.016          |
| 2005-0080     | 0.5                   | 0.8                | 27,000  | 490                | 0.75                | 0.03           | 24,000   | 360                | 0.75                | 0.025          | 24,000  | 315                | 0.75                | 0.02           |
| 2005-0100     | 0.5                   | 1                  | 27,000  | 400                | 0.75                | 0.03           | 24,000   | 300                | 0.75                | 0.025          | 24,000  | 260                | 0.75                | 0.02           |
| 2006-0100     | 0.6                   | 1                  | 24,000  | 600                | 1                   | 0.036          | 20,000   | 450                | 1                   | 0.03           | 20,000  | 400                | 1                   | 0.024          |
| 2006-0120     | 0.6                   | 1.2                | 24,000  | 500                | 1.2                 | 0.036          | 20,000   | 360                | 1.2                 | 0.03           | 20,000  | 315                | 1.2                 | 0.024          |
| 2007-0140     | 0.7                   | 1.4                | 22,500  | 500                | 1.4                 | 0.042          | 17,800   | 360                | 1.4                 | 0.035          | 17,800  | 315                | 1.4                 | 0.028          |
| 2008-0160     | 0.8                   | 1.6                | 21,000  | 500                | 1.6                 | 0.048          | 16,700   | 360                | 1.6                 | 0.04           | 16,700  | 315                | 1.6                 | 0.032          |
| 2009-0180     | 0.9                   | 1.8                | 19,500  | 500                | 1.8                 | 0.054          | 15,600   | 360                | 1.8                 | 0.045          | 15,600  | 315                | 1.8                 | 0.036          |
| 2010-0200     | 1                     | 2                  | 18,000  | 600                | 1.5                 | 0.09           | 14,500   | 450                | 1.5                 | 0.09           | 14,500  | 500                | 1.5                 | 0.06           |
| 2015-0300     | 1.5                   | 3                  | 16,000  | 900                | 2.25                | 0.135          | 13,000   | 600                | 2.25                | 0.135          | 13,000  | 750                | 2.25                | 0.09           |
| 2020-0400     | 2                     | 4                  | 12,000  | 900                | 3                   | 0.18           | 10,000   | 600                | 3                   | 0.18           | 10,000  | 750                | 3                   | 0.12           |
| 2025-0500     | 2.5                   | 5                  | 10,200  | 900                | 3.75                | 0.23           | 8,400  | 600                | 3.75                | 0.23           | 8,400   | 750                | 3.75                | 0.15           |
| 2030-0600     | 3                     | 6                  | 8,500   | 900                | 4.5                 | 0.27           | 6,800  | 600                | 4.5                 | 0.27           | 6,800   | 750                | 4.5                 | 0.18           |
| 2040-0800     | 4                     | 8                  | 7,200   | 675                | 6                   | 0.6            | 5,700  | 500                | 6                   | 0.6            | 5,700   | 575                | 6                   | 0.4            |
| 2050-1000     | 5                     | 10                 | 6,000   | 750                | 7.5                 | 0.75           | 4,800  | 550                | 7.5                 | 0.75           | 4,800   | 650                | 7.5                 | 0.5            |
| 2060-1200     | 6                     | 12                 | 5,000   | 800                | 9                   | 0.9            | 4,000  | 600                | 9                   | 0.9            | 4,000   | 650                | 9                   | 0.6            |
| 2080-1600     | 8                     | 16                 | 3,500   | 700                | 12                  | 1.2            | 2,700  | 525                | 12                  | 1.2            | 2,400   | 600                | 12                  | 0.8            |
| 2100-2000     | 10                    | 20                 | 2,300   | 600                | 15                  | 1.5            | 1,900  | 450                | 15                  | 1.5            | 1,400   | 500                | 15                  | 1              |
| 2120-2400     | 12                    | 24                 | 1,850   | 550                | 18                  | 1.8            | 1,550  | 400                | 18                  | 1.8            | 1,250   | 450                | 18                  | 1.2            |

| WORK MATERIAL |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                     |                | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                     |                |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|----------------|---|--------------------|---------------------|----------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | Milling Amount (mm) |                | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | Milling Amount (mm) |                |
|               |                       |                    |   | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |   | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |
| 2001-0020     | 0.1                   | 0.2                | 30,000  | 30                 | 0.15                | 0.005          | 24,000  | 10                 | 0.2                 | 0.003          |
| 2002-0040     | 0.2                   | 0.4                | 30,000  | 70                 | 0.3                 | 0.01           | 23,000  | 30                 | 0.4                 | 0.006          |
| 2003-0060     | 0.3                   | 0.6                | 30,000  | 110                | 0.45                | 0.015          | 20,000  | 40                 | 0.6                 | 0.009          |
| 2004-0080     | 0.4                   | 0.8                | 30,000  | 150                | 0.6                 | 0.016          | 16,800  | 50                 | 0.8                 | 0.012          |
| 2005-0080     | 0.5                   | 0.8                | 24,000  | 210                | 0.75                | 0.02           | 14,400  | 65                 | 0.8                 | 0.015          |
| 2005-0100     | 0.5                   | 1                  | 24,000  | 175                | 0.75                | 0.02           | 14,400  | 50                 | 1                   | 0.015          |
| 2006-0100     | 0.6                   | 1                  | 20,000  | 265                | 1                   | 0.024          | 12,000  | 80                 | 1                   | 0.018          |
| 2006-0120     | 0.6                   | 1.2                | 20,000  | 210                | 1.2                 | 0.024          | 12,000  | 60                 | 1.2                 | 0.018          |
| 2007-0140     | 0.7                   | 1.4                | 17,800  | 210                | 1.4                 | 0.028          | 10,000  | 60                 | 1.4                 | 0.021          |
| 2008-0160     | 0.8                   | 1.6                | 16,700  | 210                | 1.6                 | 0.032          | 8,500   | 60                 | 1.6                 | 0.024          |
| 2009-0180     | 0.9                   | 1.8                | 15,600  | 210                | 1.8                 | 0.036          | 7,300   | 60                 | 1.8                 | 0.027          |
| 2010-0200     | 1                     | 2                  | 14,500  | 300                | 1.5                 | 0.06           | 6,550   | 80                 | 1.5                 | 0.045          |
| 2015-0300     | 1.5                   | 3                  | 12,000  | 450                | 2.25                | 0.09           | 4,400   | 100                | 2.25                | 0.068          |
| 2020-0400     | 2                     | 4                  | 9,000   | 450                | 3                   | 0.12           | 3,300   | 115                | 3                   | 0.09           |
| 2025-0500     | 2.5                   | 5                  | 7,900   | 450                | 3.75                | 0.15           | 2,750   | 120                | 3.75                | 0.11           |
| 2030-0600     | 3                     | 6                  | 6,800   | 450                | 4.5                 | 0.18           | 2,200   | 130                | 4.5                 | 0.135          |
| 2040-0800     | 4                     | 8                  | 5,100   | 350                | 6                   | 0.4            | 1,650   | 150                | 6                   | 0.18           |
| 2050-1000     | 5                     | 10                 | 4,050   | 425                | 7.5                 | 0.5            | 1,300   | 160                | 7.5                 | 0.225          |
| 2060-1200     | 6                     | 12                 | 3,300   | 500                | 9                   | 0.6            | 1,100   | 180                | 9                   | 0.27           |
| 2080-1600     | 8                     | 16                 | 2,300   | 450                | 12                  | 0.8            | 800   | 130                | 12                  | 0.36           |
| 2100-2000     | 10                    | 20                 | 1,500   | 450                | 15                  | 1              | 690   | 110                | 15                  | 0.45           |
| 2120-2400     | 12                    | 24                 | 1,200   | 400                | 18                  | 1.2            | 550   | 110                | 18                  | 0.54           |

## Milling Conditions for CSS

◆ 2.5D flute length type  $2.5 < L/D \leq 3$ 

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                     |                | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                     |                | STAINLESS STEELS<br>SUS304<br>* Use water soluble or oil coolant. |                    |                     |                |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|----------------|--|--------------------|---------------------|----------------|---|--------------------|---------------------|----------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | Milling Amount (mm) |                | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | Milling Amount (mm) |                | Spindle Speed (min <sup>-1</sup> )                                | Feed Rate (mm/min) | Milling Amount (mm) |                |
|               |                       |                    |   | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |  | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |   | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |
| 2001-0025     | 0.1                   | 0.25               | 30,000  | 40                 | 0.2                 | 0.005          | 30,000   | 40                 | 0.2                 | 0.005          | 30,000  | 25                 | 0.2                 | 0.004          |
| 2002-0050     | 0.2                   | 0.5                | 30,000  | 150                | 0.4                 | 0.008          | 30,000   | 120                | 0.4                 | 0.01           | 30,000  | 65                 | 0.4                 | 0.008          |
| 2003-0075     | 0.3                   | 0.75               | 30,000  | 230                | 0.6                 | 0.012          | 30,000   | 160                | 0.6                 | 0.015          | 30,000  | 100                | 0.6                 | 0.012          |
| 2004-0100     | 0.4                   | 1                  | 30,000  | 315                | 0.8                 | 0.016          | 30,000   | 220                | 0.8                 | 0.016          | 30,000  | 140                | 0.8                 | 0.012          |
| 2005-0125     | 0.5                   | 1.25               | 27,000  | 400                | 1                   | 0.02           | 24,000   | 260                | 1                   | 0.02           | 24,000  | 155                | 1                   | 0.015          |
| 2006-0150     | 0.6                   | 1.5                | 24,000  | 500                | 1.5                 | 0.024          | 20,000   | 360                | 1.5                 | 0.024          | 20,000  | 210                | 1.5                 | 0.018          |
| 2007-0175     | 0.7                   | 1.75               | 22,500  | 500                | 1.75                | 0.028          | 17,800   | 360                | 1.75                | 0.028          | 17,800  | 210                | 1.75                | 0.021          |
| 2008-0200     | 0.8                   | 2                  | 21,000  | 500                | 2                   | 0.032          | 16,700   | 360                | 2                   | 0.032          | 16,700  | 210                | 2                   | 0.024          |
| 2009-0225     | 0.9                   | 2.25               | 19,500  | 500                | 2.25                | 0.036          | 15,600   | 360                | 2.25                | 0.036          | 15,600  | 210                | 2.25                | 0.027          |
| 2010-0250     | 1                     | 2.5                | 20,000  | 700                | 2.5                 | 0.05           | 15,000   | 500                | 2.5                 | 0.05           | 11,000  | 200                | 2.5                 | 0.05           |
| 2015-0375     | 1.5                   | 3.75               | 12,800  | 710                | 3.75                | 0.075          | 10,000   | 500                | 3.75                | 0.075          | 7,000   | 210                | 3.75                | 0.075          |
| 2020-0500     | 2                     | 5                  | 9,300   | 720                | 5                   | 0.1            | 7,500  | 510                | 5                   | 0.1            | 5,000   | 230                | 5                   | 0.1            |
| 2025-0625     | 2.5                   | 6.25               | 7,600   | 725                | 6.25                | 0.13           | 6,250  | 515                | 6.25                | 0.13           | 4,100   | 250                | 6.25                | 0.13           |
| 2030-0750     | 3                     | 7.5                | 5,900   | 730                | 7.5                 | 0.15           | 5,000  | 520                | 7.5                 | 0.15           | 3,200   | 275                | 7.5                 | 0.15           |
| 2040-1000     | 4                     | 10                 | 4,200   | 740                | 10                  | 0.4            | 3,750  | 520                | 10                  | 0.4            | 2,250   | 300                | 10                  | 0.2            |
| 2050-1250     | 5                     | 12.5               | 3,200   | 750                | 12.5                | 0.5            | 3,000  | 530                | 12.5                | 0.5            | 1,700   | 330                | 12.5                | 0.25           |
| 2060-1500     | 6                     | 15                 | 2,500   | 750                | 15                  | 0.6            | 2,500  | 530                | 15                  | 0.6            | 1,350   | 350                | 15                  | 0.3            |
| 2070-1750     | 7                     | 17.5               | 2,270   | 700                | 17.5                | 0.7            | 2,270  | 495                | 17.5                | 0.7            | 1,150   | 350                | 17.5                | 0.35           |
| 2080-2000     | 8                     | 20                 | 2,100   | 660                | 20                  | 0.8            | 2,100  | 470                | 20                  | 0.8            | 1,000   | 350                | 20                  | 0.4            |
| 2090-2250     | 9                     | 22.5               | 1,935   | 615                | 22.5                | 0.9            | 1,935  | 440                | 22.5                | 0.9            | 895   | 350                | 22.5                | 0.45           |
| 2100-2500     | 10                    | 25                 | 1,800   | 580                | 25                  | 1              | 1,800  | 410                | 25                  | 1              | 810   | 350                | 25                  | 0.5            |
| 2110-2750     | 11                    | 27.5               | 1,635   | 545                | 27.5                | 1.1            | 1,635  | 375                | 27.5                | 1.1            | 735   | 335                | 27.5                | 0.55           |
| 2120-3000     | 12                    | 30                 | 1,500   | 520                | 30                  | 1.2            | 1,500  | 350                | 30                  | 1.2            | 670   | 320                | 30                  | 0.6            |

| WORK MATERIAL |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                     |                | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                     |                |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|----------------|---|--------------------|---------------------|----------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | Milling Amount (mm) |                | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | Milling Amount (mm) |                |
|               |                       |                    |   | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |   | Side Milling       | a <sub>p</sub>      | a <sub>e</sub> |
| 2001-0025     | 0.1                   | 0.25               | 30,000  | 25                 | 0.2                 | 0.004          | 24,000  | 10                 | 0.25                | 0.002          |
| 2002-0050     | 0.2                   | 0.5                | 30,000  | 65                 | 0.4                 | 0.008          | 23,000  | 25                 | 0.5                 | 0.004          |
| 2003-0075     | 0.3                   | 0.75               | 30,000  | 100                | 0.6                 | 0.012          | 20,000  | 35                 | 0.75                | 0.006          |
| 2004-0100     | 0.4                   | 1                  | 30,000  | 140                | 0.8                 | 0.012          | 16,800  | 45                 | 1                   | 0.008          |
| 2005-0125     | 0.5                   | 1.25               | 24,000  | 155                | 1                   | 0.015          | 14,400  | 50                 | 1.25                | 0.01           |
| 2006-0150     | 0.6                   | 1.5                | 20,000  | 210                | 1.5                 | 0.018          | 12,000  | 60                 | 1.5                 | 0.012          |
| 2007-0175     | 0.7                   | 1.75               | 17,800  | 210                | 1.75                | 0.021          | 10,000  | 60                 | 1.75                | 0.014          |
| 2008-0200     | 0.8                   | 2                  | 16,700  | 210                | 2                   | 0.024          | 8,500   | 60                 | 2                   | 0.016          |
| 2009-0225     | 0.9                   | 2.25               | 15,600  | 210                | 2.25                | 0.027          | 7,300   | 60                 | 2.25                | 0.018          |
| 2010-0250     | 1                     | 2.5                | 11,000  | 200                | 2.5                 | 0.05           | 5,500   | 60                 | 2.5                 | 0.05           |
| 2015-0375     | 1.5                   | 3.75               | 7,500   | 210                | 3.75                | 0.075          | 3,750   | 65                 | 3.75                | 0.075          |
| 2020-0500     | 2                     | 5                  | 5,700   | 230                | 5                   | 0.1            | 2,850   | 70                 | 5                   | 0.1            |
| 2025-0625     | 2.5                   | 6.25               | 4,800   | 240                | 6.25                | 0.13           | 2,400   | 70                 | 6.25                | 0.13           |
| 2030-0750     | 3                     | 7.5                | 3,900   | 250                | 7.5                 | 0.15           | 1,950   | 75                 | 7.5                 | 0.15           |
| 2040-1000     | 4                     | 10                 | 2,900   | 270                | 10                  | 0.3            | 1,450   | 80                 | 10                  | 0.3            |
| 2050-1250     | 5                     | 12.5               | 2,400   | 290                | 12.5                | 0.375          | 1,200   | 90                 | 12.5                | 0.375          |
| 2060-1500     | 6                     | 15                 | 2,000   | 300                | 15                  | 0.45           | 1,000   | 100                | 15                  | 0.45           |
| 2070-1750     | 7                     | 17.5               | 1,630   | 285                | 17.5                | 0.525          | 815   | 85                 | 17.5                | 0.525          |
| 2080-2000     | 8                     | 20                 | 1,350   | 270                | 20                  | 0.6            | 675   | 70                 | 20                  | 0.6            |
| 2090-2250     | 9                     | 22.5               | 1,135   | 255                | 22.5                | 0.675          | 565   | 60                 | 22.5                | 0.675          |
| 2100-2500     | 10                    | 25                 | 960   | 240                | 25                  | 0.75           | 480   | 50                 | 25                  | 0.75           |
| 2110-2750     | 11                    | 27.5               | 845   | 220                | 27.5                | 0.825          | 425   | 45                 | 27.5                | 0.825          |
| 2120-3000     | 12                    | 30                 | 750   | 200                | 30                  | 0.9            | 375   | 40                 | 30                  | 0.9            |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



## Milling Conditions for CSS

◆ 3D flute length type L/D=3

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                |                     | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                                    |                    |                | STAINLESS STEELS<br>SUS304<br>* Use water soluble or oil coolant. |                |                                    |                    |  |                     |  |
|---------------|-----------------------|--------------------|---|--------------------|----------------|---------------------|--|------------------------------------|--------------------|----------------|---|----------------|------------------------------------|--------------------|--|---------------------|--|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) |                | Milling Amount (mm) |  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) |                | Milling Amount (mm)   |                | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) |  | Milling Amount (mm) |  |
|               |                       |                    |   | Side Milling       | a <sub>p</sub> | a <sub>e</sub>      | Side Milling   |                                    | a <sub>p</sub>     | a <sub>e</sub> | Side Milling  | a <sub>p</sub> |                                    | a <sub>e</sub>     |  |                     |  |
| 2001-0030     | 0.1                   | 0.3                | 30,000  | 30                 | 0.25           | 0.005               | 30,000   | 30                                 | 0.25               | 0.005          | 30,000  | 20             | 0.25                               | 0.004              |  |                     |  |
| 2002-0060     | 0.2                   | 0.6                | 30,000  | 110                | 0.5            | 0.008               | 30,000   | 85                                 | 0.5                | 0.01           | 30,000  | 50             | 0.5                                | 0.008              |  |                     |  |
| 2003-0090     | 0.3                   | 0.9                | 30,000  | 180                | 0.75           | 0.012               | 30,000   | 135                                | 0.75               | 0.015          | 30,000  | 80             | 0.75                               | 0.012              |  |                     |  |
| 2004-0120     | 0.4                   | 1.2                | 30,000  | 250                | 1              | 0.016               | 30,000   | 170                                | 1                  | 0.016          | 30,000  | 100            | 1                                  | 0.012              |  |                     |  |
| 2005-0150     | 0.5                   | 1.5                | 27,000  | 320                | 1.25           | 0.02                | 24,000   | 200                                | 1.25               | 0.02           | 24,000  | 125            | 1.25                               | 0.015              |  |                     |  |
| 2006-0180     | 0.6                   | 1.8                | 24,000  | 400                | 1.8            | 0.024               | 20,000   | 280                                | 1.8                | 0.024          | 20,000  | 170            | 1.8                                | 0.018              |  |                     |  |
| 2007-0210     | 0.7                   | 2.1                | 22,500  | 400                | 2.1            | 0.028               | 17,800   | 280                                | 2.1                | 0.028          | 17,800  | 170            | 2.1                                | 0.021              |  |                     |  |
| 2008-0240     | 0.8                   | 2.4                | 21,000  | 400                | 2.4            | 0.032               | 16,700   | 280                                | 2.4                | 0.032          | 16,700  | 170            | 2.4                                | 0.024              |  |                     |  |
| 2009-0270     | 0.9                   | 2.7                | 19,500  | 400                | 2.7            | 0.036               | 15,600   | 280                                | 2.7                | 0.036          | 15,600  | 170            | 2.7                                | 0.027              |  |                     |  |
| 2010-0300     | 1                     | 3                  | 20,000  | 700                | 3              | 0.05                | 15,000   | 500                                | 3                  | 0.05           | 11,000  | 200            | 3                                  | 0.05               |  |                     |  |
| 2015-0450     | 1.5                   | 4.5                | 12,800  | 710                | 4.5            | 0.075               | 10,000   | 500                                | 4.5                | 0.075          | 7,000   | 210            | 4.5                                | 0.075              |  |                     |  |
| 2020-0600     | 2                     | 6                  | 9,300   | 720                | 6              | 0.1                 | 7,500  | 510                                | 6                  | 0.1            | 5,000   | 230            | 6                                  | 0.1                |  |                     |  |
| 2025-0750     | 2.5                   | 7.5                | 7,600   | 725                | 7.5            | 0.13                | 6,250  | 515                                | 7.5                | 0.13           | 4,100   | 250            | 7.5                                | 0.13               |  |                     |  |
| 2030-0900     | 3                     | 9                  | 5,900   | 730                | 9              | 0.15                | 5,000  | 520                                | 9                  | 0.15           | 3,200   | 275            | 9                                  | 0.15               |  |                     |  |
| 2040-1200     | 4                     | 12                 | 4,200   | 740                | 12             | 0.4                 | 3,750  | 520                                | 12                 | 0.4            | 2,250   | 300            | 12                                 | 0.2                |  |                     |  |
| 2050-1500     | 5                     | 15                 | 3,200   | 750                | 15             | 0.5                 | 3,000  | 530                                | 15                 | 0.5            | 1,700   | 330            | 15                                 | 0.25               |  |                     |  |
| 2060-1800     | 6                     | 18                 | 2,500   | 750                | 18             | 0.6                 | 2,500  | 530                                | 18                 | 0.6            | 1,350   | 350            | 18                                 | 0.3                |  |                     |  |
| 2070-2100     | 7                     | 21                 | 2,270   | 700                | 21             | 0.7                 | 2,270  | 495                                | 21                 | 0.7            | 1,150   | 350            | 21                                 | 0.35               |  |                     |  |
| 2080-2400     | 8                     | 24                 | 2,100   | 660                | 24             | 0.8                 | 2,100  | 470                                | 24                 | 0.8            | 1,000   | 350            | 24                                 | 0.4                |  |                     |  |
| 2090-2700     | 9                     | 27                 | 1,935   | 615                | 27             | 0.9                 | 1,935  | 440                                | 27                 | 0.9            | 895   | 350            | 27                                 | 0.45               |  |                     |  |
| 2100-3000     | 10                    | 30                 | 1,800   | 580                | 30             | 1                   | 1,800  | 410                                | 30                 | 1              | 810   | 350            | 30                                 | 0.5                |  |                     |  |
| 2110-3300     | 11                    | 33                 | 1,635   | 545                | 33             | 1.1                 | 1,635  | 375                                | 33                 | 1.1            | 735   | 335            | 33                                 | 0.55               |  |                     |  |
| 2120-3600     | 12                    | 36                 | 1,500   | 520                | 36             | 1.2                 | 1,500  | 350                                | 36                 | 1.2            | 670   | 320            | 36                                 | 0.6                |  |                     |  |

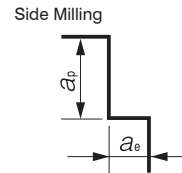
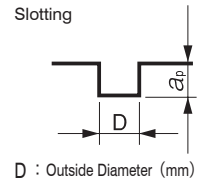
| WORK MATERIAL |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                |                     | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                                    |                    |                |                     |  |
|---------------|-----------------------|--------------------|---|--------------------|----------------|---------------------|---|------------------------------------|--------------------|----------------|---------------------|--|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) |                | Milling Amount (mm) |   | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) |                | Milling Amount (mm) |  |
|               |                       |                    |   | Side Milling       | a <sub>p</sub> | a <sub>e</sub>      | Side Milling  |                                    | a <sub>p</sub>     | a <sub>e</sub> |                     |  |
| 2001-0030     | 0.1                   | 0.3                | 30,000  | 20                 | 0.25           | 0.004               | 24,000  | 10                                 | 0.3                | 0.002          |                     |  |
| 2002-0060     | 0.2                   | 0.6                | 30,000  | 50                 | 0.5            | 0.008               | 23,000  | 20                                 | 0.6                | 0.004          |                     |  |
| 2003-0090     | 0.3                   | 0.9                | 30,000  | 80                 | 0.75           | 0.012               | 20,000  | 35                                 | 0.9                | 0.003          |                     |  |
| 2004-0120     | 0.4                   | 1.2                | 30,000  | 100                | 1              | 0.012               | 16,800  | 40                                 | 1.2                | 0.004          |                     |  |
| 2005-0150     | 0.5                   | 1.5                | 24,000  | 125                | 1.25           | 0.015               | 14,400  | 50                                 | 1.5                | 0.005          |                     |  |
| 2006-0180     | 0.6                   | 1.8                | 20,000  | 170                | 1.8            | 0.018               | 12,000  | 60                                 | 1.8                | 0.006          |                     |  |
| 2007-0210     | 0.7                   | 2.1                | 17,800  | 170                | 2.1            | 0.021               | 10,000  | 60                                 | 2.1                | 0.007          |                     |  |
| 2008-0240     | 0.8                   | 2.4                | 16,700  | 170                | 2.4            | 0.024               | 8,500   | 60                                 | 2.4                | 0.008          |                     |  |
| 2009-0270     | 0.9                   | 2.7                | 15,600  | 170                | 2.7            | 0.027               | 7,300   | 60                                 | 2.7                | 0.009          |                     |  |
| 2010-0300     | 1                     | 3                  | 11,000  | 200                | 3              | 0.05                | 5,500   | 60                                 | 3                  | 0.05           |                     |  |
| 2015-0450     | 1.5                   | 4.5                | 7,500   | 210                | 4.5            | 0.075               | 3,750   | 65                                 | 4.5                | 0.075          |                     |  |
| 2020-0600     | 2                     | 6                  | 5,700   | 230                | 6              | 0.1                 | 2,850   | 70                                 | 6                  | 0.1            |                     |  |
| 2025-0750     | 2.5                   | 7.5                | 4,800   | 240                | 7.5            | 0.13                | 2,400   | 70                                 | 7.5                | 0.13           |                     |  |
| 2030-0900     | 3                     | 9                  | 3,900   | 250                | 9              | 0.15                | 1,950   | 75                                 | 9                  | 0.15           |                     |  |
| 2040-1200     | 4                     | 12                 | 2,900   | 270                | 12             | 0.3                 | 1,450   | 80                                 | 12                 | 0.3            |                     |  |
| 2050-1500     | 5                     | 15                 | 2,400   | 290                | 15             | 0.375               | 1,200   | 90                                 | 15                 | 0.375          |                     |  |
| 2060-1800     | 6                     | 18                 | 2,000   | 300                | 18             | 0.45                | 1,000   | 100                                | 18                 | 0.45           |                     |  |
| 2070-2100     | 7                     | 21                 | 1,630   | 285                | 21             | 0.525               | 815   | 85                                 | 21                 | 0.525          |                     |  |
| 2080-2400     | 8                     | 24                 | 1,350   | 270                | 24             | 0.6                 | 675   | 70                                 | 24                 | 0.6            |                     |  |
| 2090-2700     | 9                     | 27                 | 1,135   | 255                | 27             | 0.675               | 565   | 60                                 | 27                 | 0.675          |                     |  |
| 2100-3000     | 10                    | 30                 | 960   | 240                | 30             | 0.75                | 480   | 50                                 | 30                 | 0.75           |                     |  |
| 2110-3300     | 11                    | 33                 | 845   | 220                | 33             | 0.825               | 425   | 45                                 | 33                 | 0.825          |                     |  |
| 2120-3600     | 12                    | 36                 | 750   | 200                | 36             | 0.9                 | 375   | 40                                 | 36                 | 0.9            |                     |  |



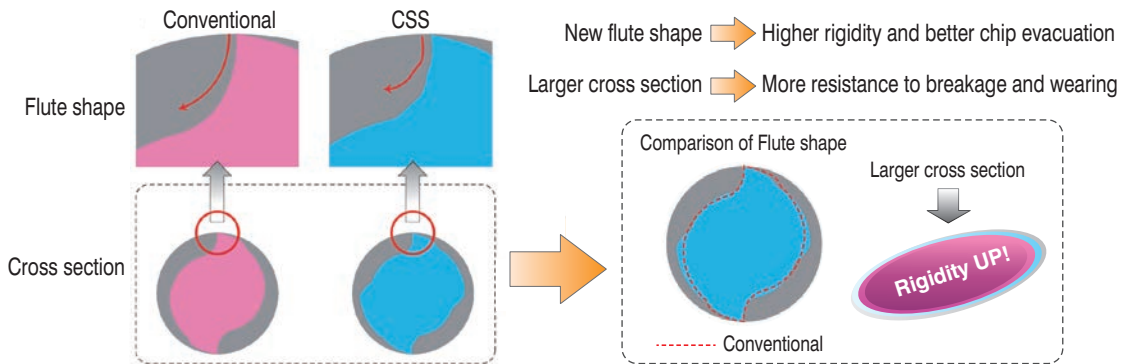
## Milling Conditions for CSS

Note:

- Decrease both spindle speed and feed rate proportionally in case of chattering.
- These milling parameters are calculated based on the shortest overhang length. Longer overhangs may require an adjustment to the milling parameters.
- Reduce the milling amount and feed rate in accordance with required milling precision.
- Recommend water soluble or oil coolant.
- Recommend oil coolant for Titanium Alloys and Heat Resistant Alloys.



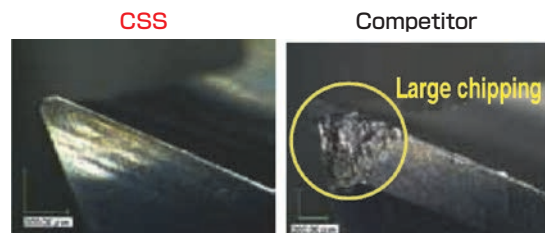
## Unique Cross Section design



## Milling Example: Slotting Comparison

|               |                            |
|---------------|----------------------------|
| Tool          | $\phi 6 \times L12$ mm     |
| Spindle Speed | 1,100 min <sup>-1</sup>    |
| Feed Rate     | 40 mm/min                  |
| $a_p$         | 1.8 mm                     |
| Coolant       | Air Blow (Through Spindle) |
| Cycle Time    | 28 min                     |

## STAVAX (53HRC)



$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.1 \sim \phi 20$

# C-CES2000



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ○      |        |        |        | ○         |                 |          | ●      |          |                       | ○               | ○                     |                  |                                       |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

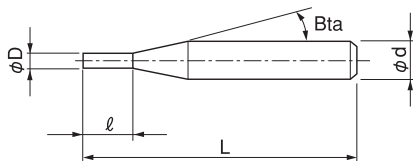
Spiral V Cutter

Drill

Technical Data

## Features

Broad application range from Copper and Carbon Steels up to Hardened Steels (55HRC).  
 Excellent performance/quality to price ratio.  
 Refer to page 194 for 4 flute C-CES.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 207 models

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle $Bta$ | Overall Length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price $\yen$ |
|-----------------|---------------------------|----------------------|-------------------------|--------------------|-------------------------|-------------------------------|
| C-CES 2001-0015 | 0.1                       | 0.15                 | 16°                     | 45                 | 4                       | 7,800                         |
| C-CES 2001-0020 |                           | 0.2                  |                         | 45                 | 4                       | 7,800                         |
| C-CES 2001-0030 |                           | 0.3                  |                         | 45                 | 4                       | 7,800                         |
| C-CES 2002-0030 | 0.2                       | 0.3                  | 16°                     | 45                 | 4                       | 4,680                         |
| C-CES 2002      |                           | 0.4                  |                         | 38                 | 3                       | 4,680                         |
| C-CES 2002-0040 |                           | 0.4                  |                         | 45                 | 4                       | 4,680                         |
| C-CES 2002-0050 |                           | 0.5                  |                         | 45                 | 4                       | 4,680                         |
| C-CES 2002-0060 |                           | 0.6                  |                         | 45                 | 4                       | 4,680                         |
| C-CES 2002-0080 |                           | 0.8                  |                         | 45                 | 4                       | 7,930                         |

Next Page ➡

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|---------------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| C-CES 2003-0045 | 0.3                       | 0.45                 | 16°                   | 45               | 4                       | 4,080                    |
| C-CES 2003      |                           | 0.6                  |                       | 38               | 3                       | 4,080                    |
| C-CES 2003-0060 |                           | 0.6                  |                       | 45               | 4                       | 4,080                    |
| C-CES 2003-0075 |                           | 0.75                 |                       | 45               | 4                       | 4,080                    |
| C-CES 2003-0090 |                           | 0.9                  |                       | 45               | 4                       | 4,080                    |
| C-CES 2003-0120 |                           | 1.2                  |                       | 45               | 4                       | 6,120                    |
| C-CES 2004-0060 | 0.4                       | 0.6                  | 16°                   | 45               | 4                       | 4,560                    |
| C-CES 2004      |                           | 0.8                  |                       | 38               | 3                       | 4,560                    |
| C-CES 2004-0080 |                           | 0.8                  |                       | 45               | 4                       | 4,560                    |
| C-CES 2004-0100 |                           | 1                    |                       | 45               | 4                       | 4,560                    |
| C-CES 2004-0120 |                           | 1.2                  |                       | 45               | 4                       | 4,560                    |
| C-CES 2004-0160 |                           | 1.6                  |                       | 45               | 4                       | 6,120                    |
| C-CES 2005-0075 | 0.5                       | 0.75                 | 16°                   | 45               | 4                       | 2,280                    |
| C-CES 2005      |                           | 0.8                  |                       | 38               | 3                       | 2,280                    |
| C-CES 2005-0100 |                           | 1                    |                       | 45               | 4                       | 2,280                    |
| C-CES 2005-0125 |                           | 1.25                 |                       | 45               | 4                       | 2,280                    |
| C-CES 2005-0150 |                           | 1.5                  |                       | 45               | 4                       | 2,280                    |
| C-CES 2005-0200 |                           | 2                    |                       | 45               | 4                       | 3,840                    |
| C-CES 2006-0090 | 0.6                       | 0.9                  | 16°                   | 45               | 4                       | 3,480                    |
| C-CES 2006      |                           | 1                    |                       | 38               | 3                       | 3,480                    |
| C-CES 2006-0120 |                           | 1.2                  |                       | 45               | 4                       | 3,480                    |
| C-CES 2006-0150 |                           | 1.5                  |                       | 45               | 4                       | 3,480                    |
| C-CES 2006-0180 |                           | 1.8                  |                       | 45               | 4                       | 3,480                    |
| C-CES 2006-0240 |                           | 2.4                  |                       | 45               | 4                       | 3,480                    |
| C-CES 2007      | 0.7                       | 1                    | 16°                   | 38               | 3                       | 3,840                    |
| C-CES 2007-0140 |                           | 1.4                  |                       | 45               | 4                       | 3,840                    |
| C-CES 2007-0175 |                           | 1.75                 |                       | 45               | 4                       | 3,840                    |
| C-CES 2007-0210 |                           | 2.1                  |                       | 45               | 4                       | 3,840                    |
| C-CES 2007-0280 |                           | 2.8                  |                       | 45               | 4                       | 3,840                    |
| C-CES 2008      | 0.8                       | 1.2                  | 16°                   | 38               | 3                       | 2,280                    |
| C-CES 2008-0120 |                           | 1.2                  |                       | 45               | 4                       | 2,280                    |
| C-CES 2008-0160 |                           | 1.6                  |                       | 45               | 4                       | 2,280                    |
| C-CES 2008-0200 |                           | 2                    |                       | 45               | 4                       | 2,280                    |
| C-CES 2008-0240 |                           | 2.4                  |                       | 45               | 4                       | 2,280                    |
| C-CES 2008-0320 |                           | 3.2                  |                       | 45               | 4                       | 3,840                    |
| C-CES 2009      | 0.9                       | 1.2                  | 16°                   | 38               | 3                       | 3,840                    |
| C-CES 2009-0180 |                           | 1.8                  |                       | 45               | 4                       | 3,840                    |
| C-CES 2009-0225 |                           | 2.25                 |                       | 45               | 4                       | 3,840                    |
| C-CES 2009-0270 |                           | 2.7                  |                       | 45               | 4                       | 3,840                    |
| C-CES 2009-0360 |                           | 3.6                  |                       | 45               | 4                       | 3,840                    |

$\phi 3\text{mm}$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Next Page →

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle $B\alpha$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|---------------------------|----------------------|-----------------------------|------------------|-------------------------|--------------------------|
| C-CES 2010-0150 | 1                         | 1.5                  | 16°                         | 45               | 4                       | 2,040                    |
| C-CES 2010-0200 |                           | 2                    |                             | 45               | 4                       | 2,040                    |
| C-CES 2010      |                           | 2.5                  |                             | 45               | 4                       | 2,040                    |
| C-CES 2010-0300 |                           | 3                    |                             | 45               | 4                       | 2,040                    |
| C-CES 2010-0400 |                           | 4                    |                             | 45               | 4                       | 3,480                    |
| C-CES 2011      | 1.1                       | 2.5                  | 16°                         | 45               | 4                       | 4,320                    |
| C-CES 2012-0180 | 1.2                       | 1.8                  | 16°                         | 45               | 4                       | 2,280                    |
| C-CES 2012-0240 |                           | 2.4                  |                             | 45               | 4                       | 2,280                    |
| C-CES 2012-0300 |                           | 3                    |                             | 45               | 4                       | 2,280                    |
| C-CES 2012-0360 |                           | 3.6                  |                             | 45               | 4                       | 2,280                    |
| C-CES 2012      |                           | 4                    |                             | 45               | 4                       | 2,280                    |
| C-CES 2012-0480 |                           | 4.8                  |                             | 45               | 4                       | 3,480                    |
| C-CES 2013      | 1.3                       | 4                    | 16°                         | 45               | 4                       | 4,320                    |
| C-CES 2014      | 1.4                       | 4                    | 16°                         | 45               | 4                       | 4,320                    |
| C-CES 2015-0225 | 1.5                       | 2.25                 | 16°                         | 45               | 4                       | 2,040                    |
| C-CES 2015-0300 |                           | 3                    |                             | 45               | 4                       | 2,040                    |
| C-CES 2015-0375 |                           | 3.75                 |                             | 45               | 4                       | 2,040                    |
| C-CES 2015      |                           | 4                    |                             | 45               | 4                       | 2,040                    |
| C-CES 2015-0450 |                           | 4.5                  |                             | 45               | 4                       | 2,040                    |
| C-CES 2015-0600 |                           | 6                    |                             | 45               | 4                       | 3,480                    |
| C-CES 2016      | 1.6                       | 5                    | 16°                         | 45               | 4                       | 4,320                    |
| C-CES 2017      | 1.7                       | 5                    | 16°                         | 45               | 4                       | 4,320                    |
| C-CES 2018-0270 | 1.8                       | 2.7                  | 16°                         | 45               | 4                       | 2,280                    |
| C-CES 2018-0360 |                           | 3.6                  |                             | 45               | 4                       | 2,280                    |
| C-CES 2018-0450 |                           | 4.5                  |                             | 45               | 4                       | 2,280                    |
| C-CES 2018      |                           | 5                    |                             | 45               | 4                       | 2,280                    |
| C-CES 2018-0540 |                           | 5.4                  |                             | 45               | 4                       | 2,280                    |
| C-CES 2018-0720 |                           | 7.2                  |                             | 45               | 4                       | 4,200                    |
| C-CES 2019      | 1.9                       | 5                    | 16°                         | 45               | 4                       | 4,440                    |
| C-CES 2020-0300 | 2                         | 3                    | 16°                         | 45               | 4                       | 2,040                    |
| C-CES 2020-0400 |                           | 4                    |                             | 45               | 4                       | 2,040                    |
| C-CES 2020-0500 |                           | 5                    |                             | 45               | 4                       | 2,040                    |
| C-CES 2020      |                           | 6                    |                             | 45               | 4                       | 2,040                    |
| C-CES 2020-0800 |                           | 8                    |                             | 45               | 4                       | 3,480                    |
| C-CES 2021      | 2.1                       | 6                    | 16°                         | 45               | 4                       | 4,320                    |
| C-CES 2022      | 2.2                       | 6                    | 16°                         | 45               | 4                       | 4,320                    |
| C-CES 2023      | 2.3                       | 6                    | 16°                         | 45               | 4                       | 4,320                    |
| C-CES 2024      | 2.4                       | 8                    | 16°                         | 45               | 4                       | 4,320                    |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|---------------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| C-CES 2025-0375 | 2.5                       | 3.75                 | 16°                   | 45               | 4                       | 2,040                    |
| C-CES 2025-0500 |                           | 5                    |                       | 45               | 4                       | 2,040                    |
| C-CES 2025-0625 |                           | 6.25                 |                       | 45               | 4                       | 2,040                    |
| C-CES 2025-0750 |                           | 7.5                  |                       | 45               | 4                       | 2,040                    |
| C-CES 2025      |                           | 8                    |                       | 45               | 4                       | 2,040                    |
| C-CES 2025-1000 |                           | 10                   |                       | 50               | 4                       | 3,480                    |
| C-CES 2026      | 2.6                       | 8                    | 16°                   | 45               | 6                       | 5,520                    |
| C-CES 2027      | 2.7                       | 8                    | 16°                   | 45               | 6                       | 5,520                    |
| C-CES 2028      | 2.8                       | 8                    | 16°                   | 45               | 6                       | 5,520                    |
| C-CES 2029      | 2.9                       | 8                    | 16°                   | 45               | 6                       | 5,520                    |
| C-CES 2030-0450 | 3                         | 4.5                  | 16°                   | 45               | 6                       | 2,640                    |
| C-CES 2030-0600 |                           | 6                    |                       | 45               | 6                       | 2,640                    |
| C-CES 2030-0750 |                           | 7.5                  |                       | 45               | 6                       | 2,640                    |
| C-CES 2030      |                           | 8                    |                       | 45               | 6                       | 2,640                    |
| C-CES 2030-0900 |                           | 9                    |                       | 45               | 6                       | 2,640                    |
| C-CES 2030-1200 |                           | 12                   |                       | 50               | 6                       | 4,320                    |
| C-CES 2031      | 3.1                       | 10                   | 16°                   | 45               | 6                       | 5,760                    |
| C-CES 2032      | 3.2                       | 10                   | 16°                   | 45               | 6                       | 5,760                    |
| C-CES 2033      | 3.3                       | 10                   | 16°                   | 45               | 6                       | 5,760                    |
| C-CES 2034      | 3.4                       | 10                   | 16°                   | 45               | 6                       | 5,760                    |
| C-CES 2035      | 3.5                       | 10                   | 16°                   | 45               | 6                       | 4,680                    |
| C-CES 2036      | 3.6                       | 10                   | 16°                   | 45               | 6                       | 5,760                    |
| C-CES 2037      | 3.7                       | 10                   | 16°                   | 45               | 6                       | 5,760                    |
| C-CES 2038      | 3.8                       | 11                   | 16°                   | 45               | 6                       | 5,760                    |
| C-CES 2039      | 3.9                       | 11                   | 16°                   | 45               | 6                       | 5,760                    |
| C-CES 2040-0600 | 4                         | 6                    | 16°                   | 50               | 6                       | 2,880                    |
| C-CES 2040-0800 |                           | 8                    |                       | 50               | 6                       | 2,880                    |
| C-CES 2040-1000 |                           | 10                   |                       | 50               | 6                       | 2,880                    |
| C-CES 2040      |                           | 11                   |                       | 45               | 6                       | 2,880                    |
| C-CES 2040-1200 |                           | 12                   |                       | 50               | 6                       | 2,880                    |
| C-CES 2040-1600 |                           | 16                   |                       | 60               | 6                       | 4,680                    |
| C-CES 2041      | 4.1                       | 11                   | 16°                   | 45               | 6                       | 5,760                    |
| C-CES 2042      | 4.2                       | 11                   | 16°                   | 45               | 6                       | 5,760                    |
| C-CES 2043      | 4.3                       | 11                   | 16°                   | 45               | 6                       | 5,760                    |
| C-CES 2044      | 4.4                       | 11                   | 16°                   | 45               | 6                       | 5,760                    |
| C-CES 2045      | 4.5                       | 11                   | 16°                   | 45               | 6                       | 5,400                    |
| C-CES 2046      | 4.6                       | 11                   | 16°                   | 45               | 6                       | 6,600                    |
| C-CES 2047      | 4.7                       | 11                   | 16°                   | 45               | 6                       | 6,600                    |
| C-CES 2048      | 4.8                       | 13                   | 16°                   | 50               | 6                       | 6,600                    |
| C-CES 2049      | 4.9                       | 13                   | 16°                   | 50               | 6                       | 6,600                    |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Next Page ➡

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|---------------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| C-CES 2050-0750 | 5                         | 7.5                  | 16°                   | 50               | 6                       | 3,120                    |
| C-CES 2050-1000 |                           | 10                   |                       | 50               | 6                       | 3,120                    |
| C-CES 2050-1250 |                           | 12.5                 |                       | 50               | 6                       | 3,120                    |
| C-CES 2050      |                           | 13                   |                       | 50               | 6                       | 3,120                    |
| C-CES 2050-1500 |                           | 15                   |                       | 50               | 6                       | 3,120                    |
| C-CES 2050-2000 |                           | 20                   |                       | 60               | 6                       | 5,280                    |
| C-CES 2051      | 5.1                       | 13                   | 16°                   | 50               | 6                       | 6,600                    |
| C-CES 2052      | 5.2                       | 13                   | 16°                   | 50               | 6                       | 6,600                    |
| C-CES 2053      | 5.3                       | 13                   | 16°                   | 50               | 6                       | 6,600                    |
| C-CES 2054      | 5.4                       | 13                   | 16°                   | 50               | 6                       | 6,600                    |
| C-CES 2055      | 5.5                       | 13                   | 16°                   | 50               | 6                       | 5,640                    |
| C-CES 2056      | 5.6                       | 13                   | 16°                   | 50               | 6                       | 5,640                    |
| C-CES 2057      | 5.7                       | 13                   | 16°                   | 50               | 6                       | 5,640                    |
| C-CES 2058      | 5.8                       | 13                   | 16°                   | 50               | 6                       | 5,640                    |
| C-CES 2059      | 5.9                       | 13                   | 16°                   | 50               | 6                       | 5,640                    |
| C-CES 2060-0900 | 6                         | 9                    | —                     | 50               | 6                       | 3,360                    |
| C-CES 2060-1200 |                           | 12                   |                       | 50               | 6                       | 3,360                    |
| C-CES 2060      |                           | 13                   |                       | 50               | 6                       | 3,360                    |
| C-CES 2060-1500 |                           | 15                   |                       | 50               | 6                       | 3,360                    |
| C-CES 2060-1800 |                           | 18                   |                       | 50               | 6                       | 3,360                    |
| C-CES 2060-2400 |                           | 24                   |                       | 60               | 6                       | 5,400                    |
| C-CES 2061      | 6.1                       | 16                   | 16°                   | 60               | 8                       | 10,340                   |
| C-CES 2062      | 6.2                       | 16                   | 16°                   | 60               | 8                       | 10,340                   |
| C-CES 2063      | 6.3                       | 16                   | 16°                   | 60               | 8                       | 10,340                   |
| C-CES 2064      | 6.4                       | 16                   | 16°                   | 60               | 8                       | 10,340                   |
| C-CES 2065      | 6.5                       | 16                   | 16°                   | 60               | 8                       | 9,280                    |
| C-CES 2066      | 6.6                       | 16                   | 16°                   | 60               | 8                       | 10,340                   |
| C-CES 2067      | 6.7                       | 16                   | 16°                   | 60               | 8                       | 10,340                   |
| C-CES 2068      | 6.8                       | 16                   | 16°                   | 60               | 8                       | 10,340                   |
| C-CES 2069      | 6.9                       | 16                   | 16°                   | 60               | 8                       | 10,340                   |
| C-CES 2070      | 7                         | 16                   | 16°                   | 60               | 8                       | 8,700                    |
| C-CES 2071      | 7.1                       | 16                   | 16°                   | 60               | 8                       | 10,340                   |
| C-CES 2072      | 7.2                       | 16                   | 16°                   | 60               | 8                       | 10,340                   |
| C-CES 2073      | 7.3                       | 16                   | 16°                   | 60               | 8                       | 10,340                   |
| C-CES 2074      | 7.4                       | 16                   | 16°                   | 60               | 8                       | 10,340                   |
| C-CES 2075      | 7.5                       | 16                   | 16°                   | 60               | 8                       | 10,360                   |
| C-CES 2076      | 7.6                       | 19                   | 16°                   | 60               | 8                       | 11,550                   |
| C-CES 2077      | 7.7                       | 19                   | 16°                   | 60               | 8                       | 11,550                   |
| C-CES 2078      | 7.8                       | 19                   | 16°                   | 60               | 8                       | 11,550                   |
| C-CES 2079      | 7.9                       | 19                   | 16°                   | 60               | 8                       | 11,550                   |

Next Page ➡

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|---------------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| C-CES 2080-1600 | 8                         | 16                   | —                     | 60               | 8                       | 6,320                    |
| C-CES 2080      |                           | 19                   |                       | 60               | 8                       | 6,320                    |
| C-CES 2080-2000 |                           | 20                   |                       | 60               | 8                       | 6,320                    |
| C-CES 2080-2400 |                           | 24                   |                       | 80               | 8                       | 6,320                    |
| C-CES 2080-3200 |                           | 32                   |                       | 80               | 8                       | 11,520                   |
| C-CES 2081      | 8.1                       | 19                   | 16°                   | 70               | 10                      | 13,860                   |
| C-CES 2082      | 8.2                       | 19                   | 16°                   | 70               | 10                      | 13,860                   |
| C-CES 2083      | 8.3                       | 19                   | 16°                   | 70               | 10                      | 13,860                   |
| C-CES 2084      | 8.4                       | 19                   | 16°                   | 70               | 10                      | 13,860                   |
| C-CES 2085      | 8.5                       | 19                   | 16°                   | 70               | 10                      | 12,420                   |
| C-CES 2086      | 8.6                       | 19                   | 16°                   | 70               | 10                      | 13,860                   |
| C-CES 2087      | 8.7                       | 19                   | 16°                   | 70               | 10                      | 13,860                   |
| C-CES 2088      | 8.8                       | 19                   | 16°                   | 70               | 10                      | 13,860                   |
| C-CES 2089      | 8.9                       | 19                   | 16°                   | 70               | 10                      | 13,860                   |
| C-CES 2090      | 9                         | 19                   | 16°                   | 70               | 10                      | 12,420                   |
| C-CES 2091      | 9.1                       | 19                   | 16°                   | 70               | 10                      | 13,860                   |
| C-CES 2092      | 9.2                       | 19                   | 16°                   | 70               | 10                      | 13,860                   |
| C-CES 2093      | 9.3                       | 19                   | 16°                   | 70               | 10                      | 13,860                   |
| C-CES 2094      | 9.4                       | 19                   | 16°                   | 70               | 10                      | 13,860                   |
| C-CES 2095      | 9.5                       | 19                   | 16°                   | 70               | 10                      | 12,870                   |
| C-CES 2096      | 9.6                       | 22                   | 16°                   | 70               | 10                      | 14,300                   |
| C-CES 2097      | 9.7                       | 22                   | 16°                   | 70               | 10                      | 14,300                   |
| C-CES 2098      | 9.8                       | 22                   | 16°                   | 70               | 10                      | 14,300                   |
| C-CES 2099      | 9.9                       | 22                   | 16°                   | 70               | 10                      | 14,300                   |
| C-CES 2100-2000 | 10                        | 20                   | —                     | 70               | 10                      | 7,580                    |
| C-CES 2100      |                           | 22                   |                       | 70               | 10                      | 7,580                    |
| C-CES 2100-2500 |                           | 25                   |                       | 70               | 10                      | 7,580                    |
| C-CES 2100-3000 |                           | 30                   |                       | 80               | 10                      | 7,580                    |
| C-CES 2100-4000 |                           | 40                   |                       | 90               | 10                      | 12,600                   |
| C-CES 2105      | 10.5                      | 22                   | 16°                   | 75               | 12                      | 18,920                   |
| C-CES 2110      | 11                        | 22                   | 16°                   | 75               | 12                      | 17,160                   |
| C-CES 2115      | 11.5                      | 22                   | 16°                   | 75               | 12                      | 19,580                   |
| C-CES 2120-2400 | 12                        | 24                   | —                     | 75               | 12                      | 11,170                   |
| C-CES 2120      |                           | 26                   |                       | 75               | 12                      | 11,170                   |
| C-CES 2120-3000 |                           | 30                   |                       | 75               | 12                      | 11,170                   |
| C-CES 2120-3600 |                           | 36                   |                       | 90               | 12                      | 11,170                   |
| C-CES 2120-4800 |                           | 48                   |                       | 100              | 12                      | 22,490                   |
| C-CES 2160      | 16                        | 32                   | —                     | 110              | 16                      | 35,530                   |
| C-CES 2180      | 18                        | 32                   | 16°                   | 110              | 20                      | 55,880                   |
| C-CES 2200      | 20                        | 38                   | —                     | 110              | 20                      | 60,500                   |

$\phi 3\text{mm}$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for C-CES (2 Flutes)

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                     |                     |                     | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                                    |                    |                     |                     |              |       |
|---------------|-----------------------|--------------------|--|--------------------|---------------------|---------------------|---------------------|---|------------------------------------|--------------------|---------------------|---------------------|--------------|-------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | Slotting            |                     | Side Milling        |   | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Slotting            |                     | Side Milling |       |
|               |                       |                    |  |                    | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm)                           |                                    |                    | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |              |       |
| 2001          | 0.1                   | 0.15               | 30,000                                   | 30                 | 0.01                | 0.15                | 0.01                | 30,000  | 30                                 | 0.01               | 0.15                | 0.01                | 0.15         | 0.01  |
|               |                       | 0.2                | 30,000                                   | 30                 | 0.01                | 0.15                | 0.01                | 30,000  | 30                                 | 0.01               | 0.15                | 0.01                | 0.15         | 0.01  |
|               |                       | 0.3                | 30,000                                   | 30                 | 0.005               | 0.25                | 0.005               | 30,000  | 30                                 | 0.005              | 0.25                | 0.005               | 0.25         | 0.005 |
| 2002          | 0.2                   | 0.3                | 30,000                                   | 85                 | 0.02                | 0.3                 | 0.02                | 30,000  | 85                                 | 0.02               | 0.3                 | 0.02                | 0.3          | 0.02  |
|               |                       | 0.4                | 30,000                                   | 85                 | 0.02                | 0.3                 | 0.02                | 30,000  | 85                                 | 0.02               | 0.3                 | 0.02                | 0.3          | 0.02  |
|               |                       | 0.5                | 30,000                                   | 85                 | 0.014               | 0.4                 | 0.014               | 30,000  | 85                                 | 0.014              | 0.4                 | 0.014               | 0.4          | 0.014 |
|               |                       | 0.6                | 30,000                                   | 85                 | 0.01                | 0.5                 | 0.01                | 30,000  | 85                                 | 0.01               | 0.5                 | 0.01                | 0.5          | 0.01  |
|               |                       | 0.8                | 30,000                                   | 85                 | 0.004               | 0.7                 | 0.004               | 30,000  | 85                                 | 0.004              | 0.7                 | 0.004               | 0.7          | 0.004 |
|               |                       | 0.45               | 30,000                                   | 110                | 0.03                | 0.45                | 0.03                | 30,000  | 110                                | 0.03               | 0.45                | 0.03                | 0.45         | 0.03  |
| 2003          | 0.3                   | 0.6                | 30,000                                   | 110                | 0.03                | 0.45                | 0.03                | 30,000  | 110                                | 0.03               | 0.45                | 0.03                | 0.45         | 0.03  |
|               |                       | 0.75               | 30,000                                   | 110                | 0.021               | 0.6                 | 0.021               | 30,000  | 110                                | 0.021              | 0.6                 | 0.021               | 0.6          | 0.021 |
|               |                       | 0.9                | 30,000                                   | 110                | 0.015               | 0.75                | 0.015               | 30,000  | 110                                | 0.015              | 0.75                | 0.015               | 0.75         | 0.015 |
|               |                       | 1.2                | 30,000                                   | 110                | 0.006               | 1.05                | 0.006               | 30,000  | 110                                | 0.006              | 1.05                | 0.006               | 1.05         | 0.006 |
| 2004          | 0.4                   | 0.6                | 30,000                                   | 120                | 0.04                | 0.6                 | 0.04                | 30,000  | 120                                | 0.04               | 0.6                 | 0.04                | 0.6          | 0.04  |
|               |                       | 0.8                | 30,000                                   | 120                | 0.04                | 0.6                 | 0.04                | 30,000  | 120                                | 0.04               | 0.6                 | 0.04                | 0.6          | 0.04  |
|               |                       | 1                  | 30,000                                   | 120                | 0.028               | 0.8                 | 0.028               | 30,000  | 120                                | 0.028              | 0.8                 | 0.028               | 0.8          | 0.028 |
|               |                       | 1.2                | 30,000                                   | 120                | 0.02                | 1                   | 0.02                | 30,000  | 120                                | 0.02               | 1                   | 0.02                | 1            | 0.02  |
|               |                       | 1.6                | 30,000                                   | 120                | 0.008               | 1.4                 | 0.008               | 30,000  | 120                                | 0.008              | 1.4                 | 0.008               | 1.4          | 0.008 |
|               |                       | 0.75               | 30,000                                   | 120                | 0.05                | 0.75                | 0.05                | 29,000  | 120                                | 0.05               | 0.75                | 0.05                | 0.75         | 0.05  |
| 2005          | 0.5                   | 0.8                | 30,000                                   | 120                | 0.05                | 0.75                | 0.05                | 29,000  | 120                                | 0.05               | 0.75                | 0.05                | 0.75         | 0.05  |
|               |                       | 1                  | 30,000                                   | 120                | 0.05                | 0.75                | 0.05                | 29,000  | 120                                | 0.05               | 0.75                | 0.05                | 0.75         | 0.05  |
|               |                       | 1.25               | 30,000                                   | 120                | 0.035               | 1                   | 0.035               | 29,000  | 120                                | 0.035              | 1                   | 0.035               | 1            | 0.035 |
|               |                       | 1.5                | 30,000                                   | 120                | 0.025               | 1.25                | 0.025               | 29,000  | 120                                | 0.025              | 1.25                | 0.025               | 1.25         | 0.025 |
|               |                       | 2                  | 30,000                                   | 120                | 0.01                | 1.75                | 0.01                | 29,000  | 120                                | 0.01               | 1.75                | 0.01                | 1.75         | 0.01  |
| 2006          | 0.6                   | 0.9                | 30,000                                   | 120                | 0.06                | 0.9                 | 0.06                | 24,000  | 120                                | 0.06               | 0.9                 | 0.06                | 0.9          | 0.06  |
|               |                       | 1                  | 30,000                                   | 120                | 0.06                | 0.9                 | 0.06                | 24,000  | 120                                | 0.06               | 0.9                 | 0.06                | 0.9          | 0.06  |
|               |                       | 1.2                | 30,000                                   | 120                | 0.06                | 0.9                 | 0.06                | 24,000  | 120                                | 0.06               | 0.9                 | 0.06                | 0.9          | 0.06  |
|               |                       | 1.5                | 30,000                                   | 120                | 0.042               | 1.2                 | 0.042               | 24,000  | 120                                | 0.042              | 1.2                 | 0.042               | 1.2          | 0.042 |
|               |                       | 1.8                | 30,000                                   | 120                | 0.03                | 1.5                 | 0.03                | 24,000  | 120                                | 0.03               | 1.5                 | 0.03                | 1.5          | 0.03  |
|               |                       | 2.4                | 30,000                                   | 120                | 0.012               | 2.1                 | 0.012               | 24,000  | 120                                | 0.012              | 2.1                 | 0.012               | 2.1          | 0.012 |
| 2007          | 0.7                   | 1                  | 27,500                                   | 120                | 0.07                | 1.05                | 0.07                | 21,000  | 120                                | 0.07               | 1.05                | 0.07                | 1.05         | 0.07  |
|               |                       | 1.4                | 27,500                                   | 120                | 0.07                | 1.05                | 0.07                | 21,000  | 120                                | 0.07               | 1.05                | 0.07                | 1.05         | 0.07  |
|               |                       | 1.75               | 27,500                                   | 120                | 0.049               | 1.4                 | 0.049               | 21,000  | 120                                | 0.049              | 1.4                 | 0.049               | 1.4          | 0.049 |
|               |                       | 2.1                | 27,500                                   | 120                | 0.035               | 1.75                | 0.035               | 21,000  | 120                                | 0.035              | 1.75                | 0.035               | 1.75         | 0.035 |
|               |                       | 2.8                | 27,500                                   | 120                | 0.014               | 2.45                | 0.014               | 21,000  | 120                                | 0.014              | 2.45                | 0.014               | 2.45         | 0.014 |
| 2008          | 0.8                   | 1.2                | 24,000                                   | 120                | 0.08                | 1.2                 | 0.08                | 19,000  | 120                                | 0.08               | 1.2                 | 0.08                | 1.2          | 0.08  |
|               |                       | 1.6                | 24,000                                   | 120                | 0.08                | 1.2                 | 0.08                | 19,000  | 120                                | 0.08               | 1.2                 | 0.08                | 1.2          | 0.08  |
|               |                       | 2                  | 24,000                                   | 120                | 0.056               | 1.6                 | 0.056               | 19,000  | 120                                | 0.056              | 1.6                 | 0.056               | 1.6          | 0.056 |
|               |                       | 2.4                | 24,000                                   | 120                | 0.04                | 2                   | 0.04                | 19,000  | 120                                | 0.04               | 2                   | 0.04                | 2            | 0.04  |
|               |                       | 3.2                | 24,000                                   | 120                | 0.016               | 2.8                 | 0.016               | 19,000  | 120                                | 0.016              | 2.8                 | 0.016               | 2.8          | 0.016 |
| 2009          | 0.9                   | 1.2                | 21,500                                   | 125                | 0.09                | 1.35                | 0.09                | 16,500  | 120                                | 0.09               | 1.35                | 0.09                | 1.35         | 0.09  |
|               |                       | 1.8                | 21,500                                   | 125                | 0.09                | 1.35                | 0.09                | 16,500  | 120                                | 0.09               | 1.35                | 0.09                | 1.35         | 0.09  |
|               |                       | 2.25               | 21,500                                   | 125                | 0.063               | 1.8                 | 0.063               | 16,500  | 120                                | 0.063              | 1.8                 | 0.063               | 1.8          | 0.063 |
|               |                       | 2.7                | 21,500                                   | 125                | 0.045               | 2.25                | 0.045               | 16,500  | 120                                | 0.045              | 2.25                | 0.045               | 2.25         | 0.045 |
|               |                       | 3.6                | 21,500                                   | 125                | 0.018               | 3.15                | 0.018               | 16,500  | 120                                | 0.018              | 3.15                | 0.018               | 3.15         | 0.018 |
| 2010          | 1                     | 1.5                | 20,000                                   | 125                | 0.25                | 1.5                 | 0.1                 | 15,000  | 120                                | 0.25               | 1.5                 | 0.1                 | 1.5          | 0.1   |
|               |                       | 2                  | 20,000                                   | 125                | 0.25                | 1.5                 | 0.1                 | 15,000  | 120                                | 0.25               | 1.5                 | 0.1                 | 1.5          | 0.1   |
|               |                       | 2.5                | 20,000                                   | 125                | 0.2                 | 2                   | 0.07                | 15,000  | 120                                | 0.2                | 2                   | 0.07                | 2            | 0.07  |
|               |                       | 3                  | 20,000                                   | 125                | 0.125               | 2.5                 | 0.05                | 15,000  | 120                                | 0.125              | 2.5                 | 0.05                | 2.5          | 0.05  |
|               |                       | 4                  | 20,000                                   | 125                | 0.075               | 3.5                 | 0.02                | 15,000  | 120                                | 0.075              | 3.5                 | 0.02                | 3.5          | 0.02  |
| 2012          | 1.2                   | 1.8                | 16,700                                   | 130                | 0.3                 | 1.8                 | 0.12                | 12,500  | 120                                | 0.3                | 1.8                 | 0.12                | 1.8          | 0.12  |
|               |                       | 2.4                | 16,700                                   | 130                | 0.3                 | 1.8                 | 0.12                | 12,500  | 120                                | 0.3                | 1.8                 | 0.12                | 1.8          | 0.12  |
|               |                       | 3                  | 16,700                                   | 130                | 0.24                | 2.4                 | 0.084               | 12,500  | 120                                | 0.24               | 2.4                 | 0.084               | 2.4          | 0.084 |
|               |                       | 3.6                | 16,700                                   | 130                | 0.15                | 3                   | 0.06                | 12,500  | 120                                | 0.15               | 3                   | 0.06                | 3            | 0.06  |
|               |                       | 4                  | 16,700                                   | 130                | 0.09                | 4                   | 0.024               | 12,500  | 120                                | 0.09               | 4                   | 0.024               | 4            | 0.024 |
|               |                       | 4.8                | 16,700                                   | 130                | 0.09                | 4.2                 | 0.024               | 12,500  | 120                                | 0.09               | 4.2                 | 0.024               | 4.2          | 0.024 |
| 2015          | 1.5                   | 2.25               | 13,500                                   | 130                | 0.375               | 2.25                | 0.15                | 10,000  | 120                                | 0.375              | 2.25                | 0.15                | 2.25         | 0.15  |
|               |                       | 3                  | 13,500                                   | 130                | 0.375               | 2.25                | 0.15                | 10,000  | 120                                | 0.375              | 2.25                | 0.15                | 2.25         | 0.15  |
|               |                       | 3.75               | 13,500                                   | 130                | 0.3                 | 3                   | 0.105               | 10,000  | 120                                | 0.3                | 3                   | 0.105               | 3            | 0.105 |
|               |                       | 4                  | 13,500                                   | 130                | 0.1875              | 3.75                | 0.075               | 10,000  | 120                                | 0.1875             | 3.75                | 0.075               | 3.75         | 0.075 |
|               |                       | 4.5                | 13,500                                   | 130                | 0.1875              | 3.75                | 0.075               | 10,000  | 120                                | 0.1875             | 3.75                | 0.075               | 3.75         | 0.075 |
|               |                       | 6                  | 13,500                                   | 130                | 0.1125              | 5.25                | 0.03                | 10,000  | 120                                | 0.1125             | 5.25                | 0.03                | 5.25         | 0.03  |



## Milling Conditions for C-CES (2 Flutes)

| WORK MATERIAL |                       |                    | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                     |                     |                     | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                     |                     |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|---------------------|---------------------|--|--------------------|---------------------|---------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | Slotting            |                     |                     | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | Side Milling        |                     |                     |
|               |                       |                    |   |                    | a <sub>p</sub> (mm) | a <sub>m</sub> (mm) | a <sub>e</sub> (mm) |  |                    | a <sub>p</sub> (mm) | a <sub>m</sub> (mm) | a <sub>e</sub> (mm) |
| 2001          | 0.1                   | 0.15               | 30,000  | 15                 | 0.01                | 0.15                | 0.01                | 30,000                                     | 10                 | 0.002               | 0.1                 | 0.005               |
|               |                       | 0.2                | 30,000  | 15                 | 0.01                | 0.15                | 0.01                | 30,000                                     | 10                 | 0.002               | 0.1                 | 0.005               |
|               |                       | 0.3                | 30,000  | 15                 | 0.005               | 0.25                | 0.005               | 30,000                                     | 10                 | 0.001               | 0.2                 | 0.002               |
| 2002          | 0.2                   | 0.3                | 30,000  | 30                 | 0.02                | 0.3                 | 0.02                | 30,000                                     | 25                 | 0.004               | 0.2                 | 0.01                |
|               |                       | 0.4                | 30,000  | 30                 | 0.02                | 0.3                 | 0.02                | 30,000                                     | 25                 | 0.004               | 0.2                 | 0.01                |
|               |                       | 0.5                | 30,000  | 30                 | 0.014               | 0.4                 | 0.014               | 30,000                                     | 25                 | 0.004               | 0.3                 | 0.006               |
|               |                       | 0.6                | 30,000  | 30                 | 0.01                | 0.5                 | 0.01                | 30,000                                     | 25                 | 0.002               | 0.4                 | 0.004               |
|               |                       | 0.8                | 30,000  | 30                 | 0.004               | 0.7                 | 0.004               | 30,000                                     | 25                 | 0.002               | 0.6                 | 0.002               |
| 2003          | 0.3                   | 0.45               | 30,000  | 55                 | 0.03                | 0.45                | 0.03                | 22,000                                     | 25                 | 0.006               | 0.3                 | 0.015               |
|               |                       | 0.6                | 30,000  | 55                 | 0.03                | 0.45                | 0.03                | 22,000                                     | 25                 | 0.006               | 0.3                 | 0.015               |
|               |                       | 0.75               | 30,000  | 55                 | 0.021               | 0.6                 | 0.021               | 22,000                                     | 25                 | 0.006               | 0.45                | 0.009               |
|               |                       | 0.9                | 30,000  | 55                 | 0.015               | 0.75                | 0.015               | 22,000                                     | 25                 | 0.003               | 0.6                 | 0.006               |
|               |                       | 1.2                | 30,000  | 55                 | 0.006               | 1.05                | 0.006               | 22,000                                     | 25                 | 0.003               | 0.9                 | 0.003               |
| 2004          | 0.4                   | 0.6                | 27,000  | 60                 | 0.04                | 0.6                 | 0.04                | 17,000                                     | 25                 | 0.008               | 0.4                 | 0.02                |
|               |                       | 0.8                | 27,000  | 60                 | 0.04                | 0.6                 | 0.04                | 17,000                                     | 25                 | 0.008               | 0.4                 | 0.02                |
|               |                       | 1                  | 27,000  | 60                 | 0.028               | 0.8                 | 0.028               | 17,000                                     | 25                 | 0.008               | 0.6                 | 0.012               |
|               |                       | 1.2                | 27,000  | 60                 | 0.02                | 1                   | 0.02                | 17,000                                     | 25                 | 0.004               | 0.8                 | 0.008               |
|               |                       | 1.6                | 27,000  | 60                 | 0.008               | 1.4                 | 0.008               | 17,000                                     | 25                 | 0.004               | 1.2                 | 0.004               |
| 2005          | 0.5                   | 0.75               | 21,500  | 60                 | 0.05                | 0.75                | 0.05                | 13,000                                     | 25                 | 0.01                | 0.5                 | 0.025               |
|               |                       | 0.8                | 21,500  | 60                 | 0.05                | 0.75                | 0.05                | 13,000                                     | 25                 | 0.01                | 0.5                 | 0.025               |
|               |                       | 1                  | 21,500  | 60                 | 0.05                | 0.75                | 0.05                | 13,000                                     | 25                 | 0.01                | 0.5                 | 0.025               |
| 2006          | 0.6                   | 1.25               | 21,500  | 60                 | 0.035               | 1                   | 0.035               | 13,000                                     | 25                 | 0.01                | 0.75                | 0.015               |
|               |                       | 1.5                | 21,500  | 60                 | 0.025               | 1.25                | 0.025               | 13,000                                     | 25                 | 0.005               | 1                   | 0.01                |
|               |                       | 2                  | 21,500  | 60                 | 0.01                | 1.75                | 0.01                | 13,000                                     | 25                 | 0.005               | 1.5                 | 0.005               |
|               |                       | 0.9                | 18,000  | 60                 | 0.06                | 0.9                 | 0.06                | 11,000                                     | 25                 | 0.012               | 0.6                 | 0.03                |
|               |                       | 1                  | 18,000  | 60                 | 0.06                | 0.9                 | 0.06                | 11,000                                     | 25                 | 0.012               | 0.6                 | 0.03                |
| 2007          | 0.7                   | 1.2                | 18,000  | 60                 | 0.06                | 0.9                 | 0.06                | 11,000                                     | 25                 | 0.012               | 0.6                 | 0.03                |
|               |                       | 1.5                | 18,000  | 60                 | 0.042               | 1.2                 | 0.042               | 11,000                                     | 25                 | 0.012               | 0.9                 | 0.018               |
|               |                       | 1.8                | 18,000  | 60                 | 0.03                | 1.5                 | 0.03                | 11,000                                     | 25                 | 0.006               | 1.2                 | 0.012               |
|               |                       | 2.4                | 18,000  | 60                 | 0.012               | 2.1                 | 0.012               | 11,000                                     | 25                 | 0.006               | 1.8                 | 0.006               |
|               |                       | 1                  | 15,500  | 60                 | 0.07                | 1.05                | 0.07                | 10,000                                     | 25                 | 0.014               | 0.7                 | 0.035               |
| 2008          | 0.8                   | 1.4                | 15,500  | 60                 | 0.07                | 1.05                | 0.07                | 10,000                                     | 25                 | 0.014               | 0.7                 | 0.035               |
|               |                       | 1.75               | 15,500  | 60                 | 0.049               | 1.4                 | 0.049               | 10,000                                     | 25                 | 0.014               | 1.05                | 0.021               |
|               |                       | 2.1                | 15,500  | 60                 | 0.035               | 1.75                | 0.035               | 10,000                                     | 25                 | 0.007               | 1.4                 | 0.014               |
|               |                       | 2.8                | 15,500  | 60                 | 0.014               | 2.45                | 0.014               | 10,000                                     | 25                 | 0.007               | 2.1                 | 0.007               |
|               |                       | 1.2                | 13,800  | 60                 | 0.08                | 1.2                 | 0.08                | 8,800                                      | 30                 | 0.016               | 0.8                 | 0.04                |
| 2009          | 0.9                   | 1.6                | 13,800  | 60                 | 0.08                | 1.2                 | 0.08                | 8,800                                      | 30                 | 0.016               | 0.8                 | 0.04                |
|               |                       | 2                  | 13,800  | 60                 | 0.056               | 1.6                 | 0.056               | 8,800                                      | 30                 | 0.016               | 1.2                 | 0.024               |
|               |                       | 2.4                | 13,800  | 60                 | 0.04                | 2                   | 0.04                | 8,800                                      | 30                 | 0.008               | 1.6                 | 0.016               |
|               |                       | 3.2                | 13,800  | 60                 | 0.016               | 2.8                 | 0.016               | 8,800                                      | 30                 | 0.008               | 2.4                 | 0.008               |
|               |                       | 1.2                | 12,000  | 65                 | 0.09                | 1.35                | 0.09                | 7,800                                      | 30                 | 0.018               | 0.9                 | 0.045               |
| 2010          | 1                     | 1.8                | 12,000  | 65                 | 0.09                | 1.35                | 0.09                | 7,800                                      | 30                 | 0.018               | 0.9                 | 0.045               |
|               |                       | 2.25               | 12,000  | 65                 | 0.063               | 1.8                 | 0.063               | 7,800                                      | 30                 | 0.018               | 1.35                | 0.027               |
|               |                       | 2.7                | 12,000  | 65                 | 0.045               | 2.25                | 0.045               | 7,800                                      | 30                 | 0.009               | 1.8                 | 0.018               |
|               |                       | 3.6                | 12,000  | 65                 | 0.018               | 3.15                | 0.018               | 7,800                                      | 30                 | 0.009               | 2.7                 | 0.009               |
|               |                       | 1.5                | 11,000  | 65                 | 0.25                | 1.5                 | 0.1                 | 7,100                                      | 30                 | 0.05                | 1                   | 0.05                |
| 2012          | 1.2                   | 2                  | 11,000  | 65                 | 0.25                | 1.5                 | 0.1                 | 7,100                                      | 30                 | 0.05                | 1                   | 0.05                |
|               |                       | 2.5                | 11,000  | 65                 | 0.2                 | 2                   | 0.07                | 7,100                                      | 30                 | 0.03                | 1.5                 | 0.03                |
|               |                       | 3                  | 11,000  | 65                 | 0.125               | 2.5                 | 0.05                | 7,100                                      | 30                 | 0.02                | 2                   | 0.02                |
|               |                       | 4                  | 11,000  | 65                 | 0.075               | 3.5                 | 0.02                | 7,100                                      | 30                 | 0.01                | 3                   | 0.01                |
|               |                       | 1.8                | 9,400   | 65                 | 0.3                 | 1.8                 | 0.12                | 6,000                                      | 30                 | 0.06                | 1.2                 | 0.06                |
| 2015          | 1.5                   | 2.4                | 9,400   | 65                 | 0.3                 | 1.8                 | 0.12                | 6,000                                      | 30                 | 0.06                | 1.2                 | 0.06                |
|               |                       | 3                  | 9,400   | 65                 | 0.24                | 2.4                 | 0.084               | 6,000                                      | 30                 | 0.036               | 1.8                 | 0.036               |
|               |                       | 3.6                | 9,400   | 65                 | 0.15                | 3                   | 0.06                | 6,000                                      | 30                 | 0.024               | 2.4                 | 0.024               |
|               |                       | 4                  | 9,400   | 65                 | 0.09                | 4                   | 0.024               | 6,000                                      | 30                 | 0.012               | 3.6                 | 0.012               |
|               |                       | 4.8                | 9,400   | 65                 | 0.09                | 4.2                 | 0.024               | 6,000                                      | 30                 | 0.012               | 3.6                 | 0.012               |
| 2015          | 1.5                   | 2.25               | 8,000   | 70                 | 0.375               | 2.25                | 0.15                | 5,100                                      | 35                 | 0.075               | 1.5                 | 0.075               |
|               |                       | 3                  | 8,000   | 70                 | 0.375               | 2.25                | 0.15                | 5,100                                      | 35                 | 0.075               | 1.5                 | 0.075               |
|               |                       | 3.75               | 8,000   | 70                 | 0.3                 | 3                   | 0.105               | 5,100                                      | 35                 | 0.045               | 2.25                | 0.045               |
|               |                       | 4                  | 8,000   | 70                 | 0.1875              | 3.75                | 0.075               | 5,100                                      | 35                 | 0.03                | 3                   | 0.03                |
|               |                       | 4.5                | 8,000   | 70                 | 0.1875              | 3.75                | 0.075               | 5,100                                      | 35                 | 0.03                | 3                   | 0.03                |
|               |                       | 6                  | 8,000   | 70                 | 0.1125              | 5.25                | 0.03                | 5,100                                      | 35                 | 0.015               | 4.5                 | 0.015               |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for C-CES (2 Flutes)

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                     |                     |                     | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                     |                     |                     |
|---------------|-----------------------|--------------------|--|--------------------|---------------------|---------------------|---------------------|---|--------------------|---------------------|---------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | Slotting            | Side Milling        |                     | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | Slotting            | Side Milling        |                     |
|               |                       |                    |  |                    | a <sub>p</sub> (mm) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |   |                    | a <sub>p</sub> (mm) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |
| 2018          | 1.8                   | 2.7                | 11,500                                   | 130                | 0.45                | 2.7                 | 0.18                | 8,800   | 120                | 0.45                | 2.7                 | 0.18                |
|               |                       | 3.6                | 11,500                                   | 130                | 0.45                | 2.7                 | 0.18                | 8,800   | 120                | 0.45                | 2.7                 | 0.18                |
|               |                       | 4.5                | 11,500                                   | 130                | 0.36                | 3.6                 | 0.126               | 8,800   | 120                | 0.36                | 3.6                 | 0.126               |
|               |                       | 5                  | 11,500                                   | 130                | 0.225               | 4.5                 | 0.09                | 8,800   | 120                | 0.225               | 4.5                 | 0.09                |
|               |                       | 5.4                | 11,500                                   | 130                | 0.225               | 4.5                 | 0.09                | 8,800   | 120                | 0.225               | 4.5                 | 0.09                |
| 2020          | 2                     | 7.2                | 11,500                                   | 130                | 0.135               | 6.3                 | 0.036               | 8,800   | 120                | 0.135               | 6.3                 | 0.036               |
|               |                       | 3                  | 11,000                                   | 130                | 0.5                 | 3                   | 0.2                 | 8,500   | 120                | 0.5                 | 3                   | 0.2                 |
|               |                       | 4                  | 11,000                                   | 130                | 0.5                 | 3                   | 0.2                 | 8,500   | 120                | 0.5                 | 3                   | 0.2                 |
|               |                       | 5                  | 11,000                                   | 130                | 0.4                 | 4                   | 0.14                | 8,500   | 120                | 0.4                 | 4                   | 0.14                |
|               |                       | 6                  | 11,000                                   | 130                | 0.25                | 5                   | 0.1                 | 8,500   | 120                | 0.25                | 5                   | 0.1                 |
| 2025          | 2.5                   | 8                  | 11,000                                   | 130                | 0.15                | 7                   | 0.04                | 8,500   | 120                | 0.15                | 7                   | 0.04                |
|               |                       | 3.75               | 8,800                                    | 195                | 0.625               | 3.75                | 0.25                | 7,000   | 135                | 0.625               | 3.75                | 0.25                |
|               |                       | 5                  | 8,800                                    | 195                | 0.625               | 3.75                | 0.25                | 7,000   | 135                | 0.625               | 3.75                | 0.25                |
|               |                       | 6.25               | 8,800                                    | 195                | 0.5                 | 5                   | 0.175               | 7,000   | 135                | 0.5                 | 5                   | 0.175               |
|               |                       | 7.5                | 8,800                                    | 195                | 0.3125              | 6.25                | 0.125               | 7,000   | 135                | 0.3125              | 6.25                | 0.125               |
| 2030          | 3                     | 8                  | 8,800                                    | 195                | 0.1875              | 8                   | 0.05                | 7,000   | 135                | 0.1875              | 8                   | 0.05                |
|               |                       | 10                 | 8,800                                    | 195                | 0.1875              | 8.75                | 0.05                | 7,000   | 135                | 0.1875              | 8.75                | 0.05                |
|               |                       | 4.5                | 7,400                                    | 195                | 1.5                 | 4.5                 | 0.3                 | 6,400   | 145                | 1.5                 | 4.5                 | 0.3                 |
|               |                       | 6                  | 7,400                                    | 195                | 1.5                 | 4.5                 | 0.3                 | 6,400   | 145                | 1.5                 | 4.5                 | 0.3                 |
|               |                       | 7.5                | 7,400                                    | 195                | 1.2                 | 6                   | 0.21                | 6,400   | 145                | 1.2                 | 6                   | 0.21                |
| 2040          | 4                     | 8                  | 7,400                                    | 195                | 0.9                 | 7.5                 | 0.15                | 6,400   | 145                | 0.9                 | 7.5                 | 0.15                |
|               |                       | 9                  | 7,400                                    | 195                | 0.9                 | 7.5                 | 0.15                | 6,400   | 145                | 0.9                 | 7.5                 | 0.15                |
|               |                       | 12                 | 7,400                                    | 195                | 0.45                | 10.5                | 0.06                | 6,400   | 145                | 0.45                | 10.5                | 0.06                |
|               |                       | 6                  | 5,900                                    | 230                | 2                   | 6                   | 0.4                 | 5,000   | 190                | 2                   | 6                   | 0.4                 |
|               |                       | 8                  | 5,900                                    | 230                | 2                   | 6                   | 0.4                 | 5,000   | 190                | 2                   | 6                   | 0.4                 |
| 2050          | 5                     | 10                 | 5,900                                    | 230                | 1.6                 | 8                   | 0.28                | 5,000   | 190                | 1.6                 | 8                   | 0.28                |
|               |                       | 11                 | 5,900                                    | 230                | 1.2                 | 10                  | 0.2                 | 5,000   | 190                | 1.2                 | 10                  | 0.2                 |
|               |                       | 12                 | 5,900                                    | 230                | 1.2                 | 10                  | 0.2                 | 5,000   | 190                | 1.2                 | 10                  | 0.2                 |
|               |                       | 16                 | 5,900                                    | 230                | 0.6                 | 14                  | 0.08                | 5,000   | 190                | 0.6                 | 14                  | 0.08                |
|               |                       | 7.5                | 5,300                                    | 310                | 2.5                 | 7.5                 | 0.5                 | 4,200   | 230                | 2.5                 | 7.5                 | 0.5                 |
| 2060          | 6                     | 10                 | 5,300                                    | 310                | 2.5                 | 7.5                 | 0.5                 | 4,200   | 230                | 2.5                 | 7.5                 | 0.5                 |
|               |                       | 12.5               | 5,300                                    | 310                | 2                   | 10                  | 0.35                | 4,200   | 230                | 2                   | 10                  | 0.35                |
|               |                       | 13                 | 5,300                                    | 310                | 1.5                 | 12.5                | 0.25                | 4,200   | 230                | 1.5                 | 12.5                | 0.25                |
|               |                       | 15                 | 5,300                                    | 310                | 1.5                 | 12.5                | 0.25                | 4,200   | 230                | 1.5                 | 12.5                | 0.25                |
|               |                       | 20                 | 5,300                                    | 310                | 0.75                | 17.5                | 0.1                 | 4,200   | 230                | 0.75                | 17.5                | 0.1                 |
| 2080          | 8                     | 9                  | 4,400                                    | 305                | 3                   | 9                   | 0.6                 | 3,500   | 230                | 3                   | 9                   | 0.6                 |
|               |                       | 12                 | 4,400                                    | 305                | 3                   | 9                   | 0.6                 | 3,500   | 230                | 3                   | 9                   | 0.6                 |
|               |                       | 13                 | 4,400                                    | 305                | 2.4                 | 12                  | 0.42                | 3,500   | 230                | 2.4                 | 12                  | 0.42                |
|               |                       | 15                 | 4,400                                    | 305                | 2.4                 | 15                  | 0.42                | 3,500   | 230                | 2.4                 | 15                  | 0.42                |
|               |                       | 18                 | 4,400                                    | 305                | 1.8                 | 15                  | 0.3                 | 3,500   | 230                | 1.8                 | 15                  | 0.3                 |
| 2100          | 10                    | 24                 | 4,400                                    | 305                | 0.9                 | 21                  | 0.12                | 3,500   | 230                | 0.9                 | 21                  | 0.12                |
|               |                       | 16                 | 3,300                                    | 290                | 4                   | 12                  | 0.8                 | 2,600   | 230                | 4                   | 12                  | 0.8                 |
|               |                       | 19                 | 3,300                                    | 290                | 3.2                 | 16                  | 0.56                | 2,600   | 230                | 3.2                 | 16                  | 0.56                |
|               |                       | 20                 | 3,300                                    | 290                | 3.2                 | 16                  | 0.56                | 2,600   | 230                | 3.2                 | 16                  | 0.56                |
|               |                       | 24                 | 3,300                                    | 290                | 2.4                 | 20                  | 0.4                 | 2,600   | 230                | 2.4                 | 20                  | 0.4                 |
| 2120          | 12                    | 32                 | 3,300                                    | 290                | 1.2                 | 28                  | 0.16                | 2,600   | 230                | 1.2                 | 28                  | 0.16                |
|               |                       | 20                 | 2,600                                    | 275                | 5                   | 15                  | 1                   | 2,100   | 225                | 5                   | 15                  | 1                   |
|               |                       | 22                 | 2,600                                    | 275                | 4                   | 20                  | 0.7                 | 2,100   | 225                | 4                   | 20                  | 0.7                 |
|               |                       | 25                 | 2,600                                    | 275                | 4                   | 20                  | 0.7                 | 2,100   | 225                | 4                   | 20                  | 0.7                 |
|               |                       | 30                 | 2,600                                    | 275                | 3                   | 25                  | 0.5                 | 2,100   | 225                | 3                   | 25                  | 0.5                 |
| 2120          | 12                    | 40                 | 2,600                                    | 275                | 1.5                 | 35                  | 0.2                 | 2,100   | 225                | 1.5                 | 35                  | 0.2                 |
|               |                       | 24                 | 2,200                                    | 275                | 6                   | 18                  | 1.2                 | 1,750   | 225                | 6                   | 18                  | 1.2                 |
|               |                       | 26                 | 2,200                                    | 275                | 4.8                 | 24                  | 0.84                | 1,750   | 225                | 4.8                 | 24                  | 0.84                |
|               |                       | 30                 | 2,200                                    | 275                | 4.8                 | 24                  | 0.84                | 1,750   | 225                | 4.8                 | 24                  | 0.84                |
|               |                       | 36                 | 2,200                                    | 275                | 3.6                 | 30                  | 0.6                 | 1,750   | 225                | 3.6                 | 30                  | 0.6                 |
| 48            | 2,200                 | 275                | 1.8                                      | 42                 | 0.24                | 1,750               | 225                 | 1.8   | 42                 | 0.24                |                     |                     |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for C-CES (2 Flutes)

| WORK MATERIAL |                       |                    | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                     |                     |                     | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                                    |                    |                     |                     |                     |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|---------------------|---------------------|--|------------------------------------|--------------------|---------------------|---------------------|---------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | Slotting            |                     | Side Milling        |  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Slotting            |                     | Side Milling        |                     |
|               |                       |                    |   |                    | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm)                        |                                    |                    | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |
| 2018          | 1.8                   | 2.7                | 7,000   | 70                 | 0.45                | 2.7                 | 0.18                | 4,400                                      | 35                                 | 0.09               | 1.8                 | 0.09                |                     |                     |
|               |                       | 3.6                | 7,000   | 70                 | 0.45                | 2.7                 | 0.18                | 4,400                                      | 35                                 | 0.09               | 1.8                 | 0.09                |                     |                     |
|               |                       | 4.5                | 7,000   | 70                 | 0.36                | 3.6                 | 0.126               | 4,400                                      | 35                                 | 0.054              | 2.7                 | 0.054               |                     |                     |
|               |                       | 5                  | 7,000   | 70                 | 0.225               | 4.5                 | 0.09                | 4,400                                      | 35                                 | 0.036              | 3.6                 | 0.036               |                     |                     |
|               |                       | 5.4                | 7,000   | 70                 | 0.225               | 4.5                 | 0.09                | 4,400                                      | 35                                 | 0.036              | 3.6                 | 0.036               |                     |                     |
| 2020          | 2                     | 7.2                | 7,000   | 70                 | 0.135               | 6.3                 | 0.036               | 4,400                                      | 35                                 | 0.018              | 5.4                 | 0.018               |                     |                     |
|               |                       | 3                  | 6,400   | 70                 | 0.5                 | 3                   | 0.2                 | 4,000                                      | 40                                 | 0.1                | 2                   | 0.1                 |                     |                     |
|               |                       | 4                  | 6,400   | 70                 | 0.5                 | 3                   | 0.2                 | 4,000                                      | 40                                 | 0.1                | 2                   | 0.1                 |                     |                     |
|               |                       | 5                  | 6,400   | 70                 | 0.4                 | 4                   | 0.14                | 4,000                                      | 40                                 | 0.06               | 3                   | 0.06                |                     |                     |
|               |                       | 6                  | 6,400   | 70                 | 0.25                | 5                   | 0.1                 | 4,000                                      | 40                                 | 0.04               | 4                   | 0.04                |                     |                     |
| 2025          | 2.5                   | 8                  | 6,400   | 70                 | 0.15                | 7                   | 0.04                | 4,000                                      | 40                                 | 0.02               | 6                   | 0.02                |                     |                     |
|               |                       | 3.75               | 5,000   | 70                 | 0.625               | 3.75                | 0.25                | 3,200                                      | 40                                 | 0.125              | 2.5                 | 0.125               |                     |                     |
|               |                       | 5                  | 5,000   | 70                 | 0.625               | 3.75                | 0.25                | 3,200                                      | 40                                 | 0.125              | 2.5                 | 0.125               |                     |                     |
|               |                       | 6.25               | 5,000   | 70                 | 0.5                 | 5                   | 0.175               | 3,200                                      | 40                                 | 0.075              | 3.75                | 0.075               |                     |                     |
|               |                       | 7.5                | 5,000   | 70                 | 0.3125              | 6.25                | 0.125               | 3,200                                      | 40                                 | 0.05               | 5                   | 0.05                |                     |                     |
| 2030          | 3                     | 8                  | 5,000   | 70                 | 0.1875              | 8                   | 0.05                | 3,200                                      | 40                                 | 0.025              | 7.5                 | 0.025               |                     |                     |
|               |                       | 10                 | 5,000   | 70                 | 0.1875              | 8.75                | 0.05                | 3,200                                      | 40                                 | 0.025              | 7.5                 | 0.025               |                     |                     |
|               |                       | 4.5                | 4,500   | 80                 | 1.5                 | 4.5                 | 0.3                 | 2,800                                      | 45                                 | 0.15               | 3                   | 0.15                |                     |                     |
|               |                       | 6                  | 4,500   | 80                 | 1.5                 | 4.5                 | 0.3                 | 2,800                                      | 45                                 | 0.15               | 3                   | 0.15                |                     |                     |
|               |                       | 7.5                | 4,500   | 80                 | 1.2                 | 6                   | 0.21                | 2,800                                      | 45                                 | 0.09               | 4.5                 | 0.09                |                     |                     |
| 2040          | 4                     | 8                  | 4,500   | 80                 | 0.9                 | 7.5                 | 0.15                | 2,800                                      | 45                                 | 0.06               | 6                   | 0.06                |                     |                     |
|               |                       | 9                  | 4,500   | 80                 | 0.9                 | 7.5                 | 0.15                | 2,800                                      | 45                                 | 0.06               | 6                   | 0.06                |                     |                     |
|               |                       | 12                 | 4,500   | 80                 | 0.45                | 10.5                | 0.06                | 2,800                                      | 45                                 | 0.03               | 9                   | 0.03                |                     |                     |
|               |                       | 6                  | 3,500   | 90                 | 2                   | 6                   | 0.4                 | 2,150                                      | 50                                 | 0.2                | 4                   | 0.2                 |                     |                     |
|               |                       | 8                  | 3,500   | 90                 | 2                   | 6                   | 0.4                 | 2,150                                      | 50                                 | 0.2                | 4                   | 0.2                 |                     |                     |
| 2050          | 5                     | 10                 | 3,500   | 90                 | 1.6                 | 8                   | 0.28                | 2,150                                      | 50                                 | 0.12               | 6                   | 0.12                |                     |                     |
|               |                       | 11                 | 3,500   | 90                 | 1.2                 | 10                  | 0.2                 | 2,150                                      | 50                                 | 0.08               | 8                   | 0.08                |                     |                     |
|               |                       | 12                 | 3,500   | 90                 | 1.2                 | 10                  | 0.2                 | 2,150                                      | 50                                 | 0.08               | 8                   | 0.08                |                     |                     |
|               |                       | 16                 | 3,500   | 90                 | 0.6                 | 14                  | 0.08                | 2,150                                      | 50                                 | 0.04               | 12                  | 0.04                |                     |                     |
|               |                       | 7.5                | 2,950   | 90                 | 2.5                 | 7.5                 | 0.5                 | 1,850                                      | 55                                 | 0.25               | 5                   | 0.25                |                     |                     |
| 2060          | 6                     | 10                 | 2,950   | 90                 | 2.5                 | 7.5                 | 0.5                 | 1,850                                      | 55                                 | 0.25               | 5                   | 0.25                |                     |                     |
|               |                       | 12.5               | 2,950   | 90                 | 2                   | 10                  | 0.35                | 1,850                                      | 55                                 | 0.15               | 7.5                 | 0.15                |                     |                     |
|               |                       | 13                 | 2,950   | 90                 | 1.5                 | 12.5                | 0.25                | 1,850                                      | 55                                 | 0.1                | 10                  | 0.1                 |                     |                     |
|               |                       | 15                 | 2,950   | 90                 | 1.5                 | 12.5                | 0.25                | 1,850                                      | 55                                 | 0.1                | 10                  | 0.1                 |                     |                     |
|               |                       | 20                 | 2,950   | 90                 | 0.75                | 17.5                | 0.1                 | 1,850                                      | 55                                 | 0.05               | 15                  | 0.05                |                     |                     |
| 2080          | 8                     | 9                  | 2,450   | 100                | 3                   | 9                   | 0.6                 | 1,500                                      | 55                                 | 0.3                | 6                   | 0.3                 |                     |                     |
|               |                       | 12                 | 2,450   | 100                | 3                   | 9                   | 0.6                 | 1,500                                      | 55                                 | 0.3                | 6                   | 0.3                 |                     |                     |
|               |                       | 13                 | 2,450   | 100                | 2.4                 | 12                  | 0.42                | 1,500                                      | 55                                 | 0.18               | 9                   | 0.18                |                     |                     |
|               |                       | 15                 | 2,450   | 100                | 2.4                 | 12                  | 0.42                | 1,500                                      | 55                                 | 0.18               | 9                   | 0.18                |                     |                     |
|               |                       | 18                 | 2,450   | 100                | 1.8                 | 15                  | 0.3                 | 1,500                                      | 55                                 | 0.12               | 12                  | 0.12                |                     |                     |
| 2100          | 10                    | 24                 | 2,450   | 100                | 0.9                 | 21                  | 0.12                | 1,500                                      | 55                                 | 0.06               | 18                  | 0.06                |                     |                     |
|               |                       | 16                 | 1,850   | 95                 | 4                   | 12                  | 0.8                 | 1,200                                      | 50                                 | 0.4                | 8                   | 0.4                 |                     |                     |
|               |                       | 19                 | 1,850   | 95                 | 3.2                 | 16                  | 0.56                | 1,200                                      | 50                                 | 0.24               | 12                  | 0.24                |                     |                     |
|               |                       | 20                 | 1,850   | 95                 | 3.2                 | 16                  | 0.56                | 1,200                                      | 50                                 | 0.24               | 12                  | 0.24                |                     |                     |
|               |                       | 24                 | 1,850   | 95                 | 2.4                 | 20                  | 0.4                 | 1,200                                      | 50                                 | 0.16               | 16                  | 0.16                |                     |                     |
| 2120          | 12                    | 32                 | 1,850   | 95                 | 1.2                 | 28                  | 0.16                | 1,200                                      | 50                                 | 0.08               | 24                  | 0.08                |                     |                     |
|               |                       | 20                 | 1,450   | 95                 | 5                   | 15                  | 1                   | 950  | 50                                 | 0.5                | 10                  | 0.5                 |                     |                     |
|               |                       | 22                 | 1,450   | 95                 | 4                   | 20                  | 0.7                 | 950  | 50                                 | 0.3                | 15                  | 0.3                 |                     |                     |
|               |                       | 25                 | 1,450   | 95                 | 4                   | 20                  | 0.7                 | 950  | 50                                 | 0.3                | 15                  | 0.3                 |                     |                     |
|               |                       | 30                 | 1,450   | 95                 | 3                   | 25                  | 0.5                 | 950  | 50                                 | 0.2                | 20                  | 0.2                 |                     |                     |
| 2120          | 12                    | 40                 | 1,450   | 95                 | 1.5                 | 35                  | 0.2                 | 950  | 50                                 | 0.1                | 30                  | 0.1                 |                     |                     |
|               |                       | 24                 | 1,200   | 90                 | 6                   | 18                  | 1.2                 | 800  | 45                                 | 0.6                | 12                  | 0.6                 |                     |                     |
|               |                       | 26                 | 1,200   | 90                 | 4.8                 | 24                  | 0.84                | 800  | 45                                 | 0.36               | 18                  | 0.36                |                     |                     |
|               |                       | 30                 | 1,200   | 90                 | 4.8                 | 24                  | 0.84                | 800  | 45                                 | 0.36               | 18                  | 0.36                |                     |                     |
|               |                       | 36                 | 1,200   | 90                 | 3.6                 | 30                  | 0.6                 | 800  | 45                                 | 0.24               | 24                  | 0.24                |                     |                     |
| 2120          | 12                    | 48                 | 1,200   | 90                 | 1.8                 | 42                  | 0.24                | 800  | 45                                 | 0.12               | 36                  | 0.12                |                     |                     |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for C-CES (2 Flutes)

◆High speed milling

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                     |                     |                     | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                                    |                    |                     |                     |              |  |
|---------------|-----------------------|--------------------|--|--------------------|---------------------|---------------------|---------------------|---|------------------------------------|--------------------|---------------------|---------------------|--------------|--|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | Slotting            |                     | Side Milling        |   | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Slotting            |                     | Side Milling |  |
|               |                       |                    |  |                    | a <sub>o</sub> (mm) | a <sub>e</sub> (mm) | a <sub>o</sub> (mm) | a <sub>e</sub> (mm)                           |                                    |                    | a <sub>o</sub> (mm) | a <sub>e</sub> (mm) |              |  |
| 2030          | 3                     | 4.5                | 30,000                                   | 790                | 1.5                 | 4.5                 | 0.3                 | 26,500  | 600                                | 1.5                | 4.5                 | 0.3                 |              |  |
|               |                       | 6                  | 30,000                                   | 790                | 1.5                 | 4.5                 | 0.3                 | 26,500  | 600                                | 1.5                | 4.5                 | 0.3                 |              |  |
|               |                       | 7.5                | 30,000                                   | 790                | 1.2                 | 6                   | 0.21                | 26,500  | 600                                | 1.2                | 6                   | 0.21                |              |  |
|               |                       | 8                  | 30,000                                   | 790                | 0.9                 | 7.5                 | 0.15                | 26,500  | 600                                | 0.9                | 7.5                 | 0.15                |              |  |
|               |                       | 12                 | 30,000                                   | 790                | 0.45                | 10.5                | 0.06                | 26,500  | 600                                | 0.45               | 10.5                | 0.06                |              |  |
| 2040          | 4                     | 6                  | 23,800                                   | 930                | 2                   | 6                   | 0.4                 | 19,800  | 750                                | 2                  | 6                   | 0.4                 |              |  |
|               |                       | 8                  | 23,800                                   | 930                | 2                   | 6                   | 0.4                 | 19,800  | 750                                | 2                  | 6                   | 0.4                 |              |  |
|               |                       | 10                 | 23,800                                   | 930                | 1.6                 | 8                   | 0.28                | 19,800  | 750                                | 1.6                | 8                   | 0.28                |              |  |
|               |                       | 11                 | 23,800                                   | 930                | 1.2                 | 10                  | 0.2                 | 19,800  | 750                                | 1.2                | 10                  | 0.2                 |              |  |
|               |                       | 12                 | 23,800                                   | 930                | 1.2                 | 10                  | 0.2                 | 19,800  | 750                                | 1.2                | 10                  | 0.2                 |              |  |
| 2050          | 5                     | 16                 | 23,800                                   | 930                | 0.6                 | 14                  | 0.08                | 19,800  | 750                                | 0.6                | 14                  | 0.08                |              |  |
|               |                       | 7.5                | 19,000                                   | 1,110              | 2.5                 | 7.5                 | 0.5                 | 15,800  | 865                                | 2.5                | 7.5                 | 0.5                 |              |  |
|               |                       | 10                 | 19,000                                   | 1,110              | 2.5                 | 7.5                 | 0.5                 | 15,800  | 865                                | 2.5                | 7.5                 | 0.5                 |              |  |
|               |                       | 12.5               | 19,000                                   | 1,110              | 2                   | 10                  | 0.35                | 15,800  | 865                                | 2                  | 10                  | 0.35                |              |  |
|               |                       | 13                 | 19,000                                   | 1,110              | 1.5                 | 12.5                | 0.25                | 15,800  | 865                                | 1.5                | 12.5                | 0.25                |              |  |
| 2060          | 6                     | 15                 | 19,000                                   | 1,110              | 1.5                 | 12.5                | 0.25                | 15,800  | 865                                | 1.5                | 12.5                | 0.25                |              |  |
|               |                       | 20                 | 19,000                                   | 1,110              | 0.75                | 17.5                | 0.1                 | 15,800  | 865                                | 0.75               | 17.5                | 0.1                 |              |  |
|               |                       | 9                  | 15,900                                   | 1,110              | 3                   | 9                   | 0.6                 | 13,200  | 865                                | 3                  | 9                   | 0.6                 |              |  |
|               |                       | 12                 | 15,900                                   | 1,110              | 3                   | 9                   | 0.6                 | 13,200  | 865                                | 3                  | 9                   | 0.6                 |              |  |
|               |                       | 13                 | 15,900                                   | 1,110              | 2.4                 | 12                  | 0.42                | 13,200  | 865                                | 2.4                | 12                  | 0.42                |              |  |
| 2080          | 8                     | 15                 | 15,900                                   | 1,110              | 2.4                 | 12                  | 0.42                | 13,200  | 865                                | 2.4                | 12                  | 0.42                |              |  |
|               |                       | 18                 | 15,900                                   | 1,110              | 1.8                 | 15                  | 0.3                 | 13,200  | 865                                | 1.8                | 15                  | 0.3                 |              |  |
|               |                       | 24                 | 15,900                                   | 1,110              | 0.9                 | 21                  | 0.12                | 13,200  | 865                                | 0.9                | 21                  | 0.12                |              |  |
|               |                       | 16                 | 11,900                                   | 1,045              | 4                   | 12                  | 0.8                 | 9,900   | 875                                | 4                  | 12                  | 0.8                 |              |  |
|               |                       | 19                 | 11,900                                   | 1,045              | 3.2                 | 16                  | 0.56                | 9,900   | 875                                | 3.2                | 16                  | 0.56                |              |  |
| 2100          | 10                    | 20                 | 11,900                                   | 1,045              | 3.2                 | 16                  | 0.56                | 9,900   | 875                                | 3.2                | 16                  | 0.56                |              |  |
|               |                       | 24                 | 11,900                                   | 1,045              | 2.4                 | 20                  | 0.4                 | 9,900   | 875                                | 2.4                | 20                  | 0.4                 |              |  |
|               |                       | 32                 | 11,900                                   | 1,045              | 1.2                 | 28                  | 0.16                | 9,900   | 875                                | 1.2                | 28                  | 0.16                |              |  |
|               |                       | 20                 | 9,500                                    | 1,005              | 5                   | 15                  | 1                   | 7,900   | 845                                | 5                  | 15                  | 1                   |              |  |
|               |                       | 22                 | 9,500                                    | 1,005              | 4                   | 20                  | 0.7                 | 7,900   | 845                                | 4                  | 20                  | 0.7                 |              |  |
| 2120          | 12                    | 25                 | 9,500                                    | 1,005              | 4                   | 20                  | 0.7                 | 7,900   | 845                                | 4                  | 20                  | 0.7                 |              |  |
|               |                       | 30                 | 9,500                                    | 1,005              | 3                   | 25                  | 0.5                 | 7,900   | 845                                | 3                  | 25                  | 0.5                 |              |  |
|               |                       | 24                 | 7,900                                    | 1,000              | 6                   | 18                  | 1.2                 | 6,600   | 850                                | 6                  | 18                  | 1.2                 |              |  |
|               |                       | 26                 | 7,900                                    | 1,000              | 4.8                 | 24                  | 0.84                | 6,600   | 850                                | 4.8                | 24                  | 0.84                |              |  |
|               |                       | 30                 | 7,900                                    | 1,000              | 4.8                 | 24                  | 0.84                | 6,600   | 850                                | 4.8                | 24                  | 0.84                |              |  |
|               |                       | 36                 | 7,900                                    | 1,000              | 3.6                 | 30                  | 0.6                 | 6,600   | 850                                | 3.6                | 30                  | 0.6                 |              |  |
|               |                       | 48                 | 7,900                                    | 1,000              | 1.8                 | 42                  | 0.24                | 6,600   | 850                                | 1.8                | 42                  | 0.24                |              |  |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

## Milling Conditions for C-CES (2 Flutes)

| WORK MATERIAL |                       |                    | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                     |                     |                     | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                                    |                    |                     |                     |              |  |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|---------------------|---------------------|--|------------------------------------|--------------------|---------------------|---------------------|--------------|--|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | Slotting            |                     | Side Milling        |  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Slotting            |                     | Side Milling |  |
|               |                       |                    |   |                    | a <sub>o</sub> (mm) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | a <sub>o</sub> (mm)                        |                                    |                    | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |              |  |
| 2030          | 3                     | 4.5                | 21,200  | 375                | 1.5                 | 4.5                 | 0.3                 | 15,800                                     | 255                                | 0.15               | 3                   | 0.15                |              |  |
|               |                       | 6                  | 21,200  | 375                | 1.5                 | 4.5                 | 0.3                 | 15,800                                     | 255                                | 0.15               | 3                   | 0.15                |              |  |
|               |                       | 7.5                | 21,200  | 375                | 1.2                 | 6                   | 0.21                | 15,800                                     | 255                                | 0.09               | 4.5                 | 0.09                |              |  |
|               |                       | 8                  | 21,200  | 375                | 0.9                 | 7.5                 | 0.15                | 15,800                                     | 255                                | 0.06               | 6                   | 0.06                |              |  |
|               |                       | 9                  | 21,200  | 375                | 0.9                 | 7.5                 | 0.15                | 15,800                                     | 255                                | 0.06               | 6                   | 0.06                |              |  |
|               |                       | 12                 | 21,200  | 375                | 0.45                | 10.5                | 0.06                | 15,800                                     | 255                                | 0.03               | 9                   | 0.03                |              |  |
| 2040          | 4                     | 6                  | 15,800  | 405                | 2                   | 6                   | 0.4                 | 11,900                                     | 275                                | 0.2                | 4                   | 0.2                 |              |  |
|               |                       | 8                  | 15,800  | 405                | 2                   | 6                   | 0.4                 | 11,900                                     | 275                                | 0.2                | 4                   | 0.2                 |              |  |
|               |                       | 10                 | 15,800  | 405                | 1.6                 | 8                   | 0.28                | 11,900                                     | 275                                | 0.12               | 6                   | 0.12                |              |  |
|               |                       | 11                 | 15,800  | 405                | 1.2                 | 10                  | 0.2                 | 11,900                                     | 275                                | 0.08               | 8                   | 0.08                |              |  |
|               |                       | 12                 | 15,800  | 405                | 1.2                 | 10                  | 0.2                 | 11,900                                     | 275                                | 0.08               | 8                   | 0.08                |              |  |
|               |                       | 16                 | 15,800  | 405                | 0.6                 | 14                  | 0.08                | 11,900                                     | 275                                | 0.04               | 12                  | 0.04                |              |  |
| 2050          | 5                     | 7.5                | 12,700  | 385                | 2.5                 | 7.5                 | 0.5                 | 9,500                                      | 280                                | 0.25               | 5                   | 0.25                |              |  |
|               |                       | 10                 | 12,700  | 385                | 2.5                 | 7.5                 | 0.5                 | 9,500                                      | 280                                | 0.25               | 5                   | 0.25                |              |  |
|               |                       | 12.5               | 12,700  | 385                | 2                   | 10                  | 0.35                | 9,500                                      | 280                                | 0.15               | 7.5                 | 0.15                |              |  |
|               |                       | 13                 | 12,700  | 385                | 1.5                 | 12.5                | 0.25                | 9,500                                      | 280                                | 0.1                | 10                  | 0.1                 |              |  |
|               |                       | 15                 | 12,700  | 385                | 1.5                 | 12.5                | 0.25                | 9,500                                      | 280                                | 0.1                | 10                  | 0.1                 |              |  |
|               |                       | 20                 | 12,700  | 385                | 0.75                | 17.5                | 0.1                 | 9,500                                      | 280                                | 0.05               | 15                  | 0.05                |              |  |
| 2060          | 6                     | 9                  | 10,600  | 435                | 3                   | 9                   | 0.6                 | 7,900                                      | 290                                | 0.3                | 6                   | 0.3                 |              |  |
|               |                       | 12                 | 10,600  | 435                | 3                   | 9                   | 0.6                 | 7,900                                      | 290                                | 0.3                | 6                   | 0.3                 |              |  |
|               |                       | 13                 | 10,600  | 435                | 2.4                 | 12                  | 0.42                | 7,900                                      | 290                                | 0.18               | 9                   | 0.18                |              |  |
|               |                       | 15                 | 10,600  | 435                | 2.4                 | 12                  | 0.42                | 7,900                                      | 290                                | 0.18               | 9                   | 0.18                |              |  |
|               |                       | 18                 | 10,600  | 435                | 1.8                 | 15                  | 0.3                 | 7,900                                      | 290                                | 0.12               | 12                  | 0.12                |              |  |
|               |                       | 24                 | 10,600  | 435                | 0.9                 | 21                  | 0.12                | 7,900                                      | 290                                | 0.06               | 18                  | 0.06                |              |  |
| 2080          | 8                     | 16                 | 7,900   | 405                | 4                   | 12                  | 0.8                 | 5,900                                      | 245                                | 0.4                | 8                   | 0.4                 |              |  |
|               |                       | 19                 | 7,900   | 405                | 3.2                 | 16                  | 0.56                | 5,900                                      | 245                                | 0.24               | 12                  | 0.24                |              |  |
|               |                       | 20                 | 7,900   | 405                | 3.2                 | 16                  | 0.56                | 5,900                                      | 245                                | 0.24               | 12                  | 0.24                |              |  |
|               |                       | 24                 | 7,900   | 405                | 2.4                 | 20                  | 0.4                 | 5,900                                      | 245                                | 0.16               | 16                  | 0.16                |              |  |
|               |                       | 32                 | 7,900   | 405                | 1.2                 | 28                  | 0.16                | 5,900                                      | 245                                | 0.08               | 24                  | 0.08                |              |  |
| 2100          | 10                    | 20                 | 6,300   | 415                | 5                   | 15                  | 1                   | 4,700                                      | 245                                | 0.5                | 10                  | 0.5                 |              |  |
|               |                       | 22                 | 6,300   | 415                | 4                   | 20                  | 0.7                 | 4,700                                      | 245                                | 0.3                | 15                  | 0.3                 |              |  |
|               |                       | 25                 | 6,300   | 415                | 4                   | 20                  | 0.7                 | 4,700                                      | 245                                | 0.3                | 15                  | 0.3                 |              |  |
|               |                       | 30                 | 6,300   | 415                | 3                   | 25                  | 0.5                 | 4,700                                      | 245                                | 0.2                | 20                  | 0.2                 |              |  |
| 2120          | 12                    | 24                 | 5,300   | 400                | 6                   | 18                  | 1.2                 | 3,900                                      | 219                                | 0.6                | 12                  | 0.6                 |              |  |
|               |                       | 26                 | 5,300   | 400                | 4.8                 | 24                  | 0.84                | 3,900                                      | 219                                | 0.36               | 18                  | 0.36                |              |  |
|               |                       | 30                 | 5,300   | 400                | 4.8                 | 24                  | 0.84                | 3,900                                      | 219                                | 0.36               | 18                  | 0.36                |              |  |
|               |                       | 36                 | 5,300   | 400                | 3.6                 | 30                  | 0.6                 | 3,900                                      | 219                                | 0.24               | 24                  | 0.24                |              |  |
|               |                       | 48                 | 5,300   | 400                | 1.8                 | 42                  | 0.24                | 3,900                                      | 219                                | 0.12               | 36                  | 0.12                |              |  |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

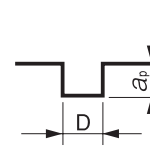
## Milling Conditions for C-CES (2 Flutes)

Milling amount for slotting (mm)  
 $D < \phi 1$

| Length of Cut \ Work Material | 2D or below | 2.5D or below | 3D or below | 4D or below |
|-------------------------------|-------------|---------------|-------------|-------------|
| 45HRC or below                | $a_p=0.1D$  | $a_p=0.07D$   | $a_p=0.05D$ | $a_p=0.02D$ |
| 45HRC or above                | $a_p=0.02D$ | $a_p=0.02D$   | $a_p=0.01D$ | $a_p=0.01D$ |

$\phi 1 \leq D < \phi 3$

| Length of Cut \ Work Material | 2D or below | 2.5D or below | 3D or below  | 4D or below  |
|-------------------------------|-------------|---------------|--------------|--------------|
| 45HRC or below                | $a_p=0.25D$ | $a_p=0.2D$    | $a_p=0.125D$ | $a_p=0.075D$ |
| 45HRC or above                | $a_p=0.05D$ | $a_p=0.03D$   | $a_p=0.02D$  | $a_p=0.01D$  |

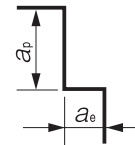


$\phi 3 \leq D$

| Length of Cut \ Work Material | 2D or below | 2.5D or below | 3D or below | 4D or below |
|-------------------------------|-------------|---------------|-------------|-------------|
| 45HRC or below                | $a_p=0.5D$  | $a_p=0.4D$    | $a_p=0.3D$  | $a_p=0.15D$ |
| 45HRC or above                | $a_p=0.05D$ | $a_p=0.03D$   | $a_p=0.02D$ | $a_p=0.01D$ |

Milling amount for side milling (mm)

| Length of Cut \ Work Material | 2D or below              | 2.5D or below             | 3D or below               | 4D or below               |
|-------------------------------|--------------------------|---------------------------|---------------------------|---------------------------|
| 45HRC or below                | $a_p=1.5D$<br>$a_e=0.1D$ | $a_p=2D$<br>$a_e=0.07D$   | $a_p=2.5D$<br>$a_e=0.05D$ | $a_p=3.5D$<br>$a_e=0.02D$ |
| 45HRC or above                | $a_p=1D$<br>$a_e=0.05D$  | $a_p=1.5D$<br>$a_e=0.03D$ | $a_p=2D$<br>$a_e=0.02D$   | $a_p=3D$<br>$a_e=0.01D$   |



D : Outside Diameter (mm)

Ex.) 2D or below : Flute Length = Diameter  $\times$  2 or below

Note:

- Recommend water soluble or oil coolant.
- Recommend oil coolant for Titanium Alloys and Heat Resistant Alloys.

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

∅3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.2 \sim \phi 12$

# C-CES2000S



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ○      |        |        |        | ○         |                 |          | ●      |          |                       | ○               | ○                     |                  |                                       |

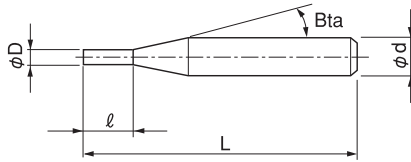
## Features

2 flute C-CES with a sharp corner design.

Broad application range from Copper and Carbon Steels up to Hardened Steels (55HRC).

Excellent performance/quality to price ratio.

Refer to page 200 for 4 flute C-CES-S.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 35 models

Unit (mm)

| Model Number     | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle $Bta$ | Overall Length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price $\yen$ |
|------------------|---------------------------|----------------------|-------------------------|--------------------|-------------------------|-------------------------------|
| C-CES 2002-0030S | 0.2                       | 0.3                  | 16°                     | 45                 | 4                       | 4,680                         |
| C-CES 2002-0060S |                           | 0.6                  |                         | 45                 |                         |                               |
| C-CES 2003-0045S | 0.3                       | 0.45                 | 16°                     | 45                 | 4                       | 4,080                         |
| C-CES 2003-0090S |                           | 0.9                  |                         | 45                 |                         |                               |
| C-CES 2004-0060S | 0.4                       | 0.6                  | 16°                     | 45                 | 4                       | 4,560                         |
| C-CES 2004-0120S |                           | 1.2                  |                         | 45                 |                         |                               |
| C-CES 2005-0075S | 0.5                       | 0.75                 | 16°                     | 45                 | 4                       | 2,280                         |
| C-CES 2005-0150S |                           | 1.5                  |                         | 45                 |                         |                               |
| C-CES 2006-0090S | 0.6                       | 0.9                  | 16°                     | 45                 | 4                       | 3,480                         |
| C-CES 2007-0105S | 0.7                       | 1.05                 | 16°                     | 45                 | 4                       | 3,840                         |
| C-CES 2008-0120S | 0.8                       | 1.2                  | 16°                     | 45                 | 4                       | 2,280                         |
| C-CES 2008-0240S |                           | 2.4                  |                         | 45                 |                         |                               |
| C-CES 2009-0135S | 0.9                       | 1.35                 | 16°                     | 45                 | 4                       | 3,840                         |
| C-CES 2010-0150S | 1                         | 1.5                  | 16°                     | 45                 | 4                       | 2,040                         |
| C-CES 2010-0300S |                           | 3                    |                         | 45                 |                         |                               |
| C-CES 2012-0180S | 1.2                       | 1.8                  | 16°                     | 45                 | 4                       | 2,280                         |
| C-CES 2012-0360S |                           | 3.6                  |                         | 45                 |                         |                               |

Next Page ➡



Unit (mm)

| Model Number     | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle $B\alpha$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|------------------|---------------------------|----------------------|-----------------------------|------------------|-------------------------|--------------------------|
| C-CES 2015-0225S | 1.5                       | 2.25                 | 16°                         | 45               | 4                       | 2,040                    |
| C-CES 2015-0450S |                           | 4.5                  |                             | 45               | 4                       | 2,040                    |
| C-CES 2018-0270S | 1.8                       | 2.7                  | 16°                         | 45               | 4                       | 2,280                    |
| C-CES 2018-0540S |                           | 5.4                  |                             | 45               | 4                       | 2,280                    |
| C-CES 2020-0300S | 2                         | 3                    | 16°                         | 45               | 4                       | 2,040                    |
| C-CES 2020-0600S |                           | 6                    |                             | 45               | 4                       | 2,040                    |
| C-CES 2025-0375S | 2.5                       | 3.75                 | 16°                         | 45               | 4                       | 2,040                    |
| C-CES 2030-0450S | 3                         | 4.5                  | 16°                         | 45               | 6                       | 2,640                    |
| C-CES 2030-0900S |                           | 9                    |                             | 45               | 6                       | 2,640                    |
| C-CES 2040-0600S | 4                         | 6                    | 16°                         | 50               | 6                       | 2,880                    |
| C-CES 2040-1200S |                           | 12                   |                             | 50               | 6                       | 2,880                    |
| C-CES 2050-0750S | 5                         | 7.5                  | 16°                         | 50               | 6                       | 3,120                    |
| C-CES 2050-1500S |                           | 15                   |                             | 50               | 6                       | 3,120                    |
| C-CES 2060-0900S | 6                         | 9                    | —                           | 50               | 6                       | 3,360                    |
| C-CES 2060-1800S |                           | 18                   |                             | 50               | 6                       | 3,360                    |
| C-CES 2080-2400S | 8                         | 24                   | —                           | 80               | 8                       | 6,320                    |
| C-CES 2100-3000S | 10                        | 30                   | —                           | 80               | 10                      | 7,580                    |
| C-CES 2120-3600S | 12                        | 36                   | —                           | 90               | 12                      | 11,170                   |

$\phi 3\text{mm}$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral

Spiral  
V Cutter

Drill

Drill

Technical Data

Technical Data

Milling Conditions for C-CES-S (2 Flutes)

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                     |                     |                     | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                     |                     |                     |
|---------------|-----------------------|--------------------|--|--------------------|---------------------|---------------------|---------------------|---|--------------------|---------------------|---------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | Slotting            | Side Milling        |                     | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | Slotting            | Side Milling        |                     |
|               |                       |                    |  |                    | a <sub>p</sub> (mm) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |   |                    | a <sub>p</sub> (mm) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |
| <b>2002</b>   | <b>0.2</b>            | 0.3                | 27,000                                   | 60                 | 0.02                | 0.3                 | 0.02                | 27,000  | 60                 | 0.02                | 0.3                 | 0.02                |
|               |                       | 0.6                | 27,000                                   | 60                 | 0.01                | 0.5                 | 0.01                | 27,000  | 60                 | 0.01                | 0.5                 | 0.01                |
| <b>2003</b>   | <b>0.3</b>            | 0.45               | 27,000                                   | 77                 | 0.03                | 0.45                | 0.03                | 27,000  | 77                 | 0.03                | 0.45                | 0.03                |
|               |                       | 0.9                | 27,000                                   | 77                 | 0.015               | 0.75                | 0.015               | 27,000  | 77                 | 0.015               | 0.75                | 0.015               |
| <b>2004</b>   | <b>0.4</b>            | 0.6                | 27,000                                   | 84                 | 0.04                | 0.6                 | 0.04                | 27,000  | 84                 | 0.04                | 0.6                 | 0.04                |
|               |                       | 1.2                | 27,000                                   | 84                 | 0.02                | 1                   | 0.02                | 27,000  | 84                 | 0.02                | 1                   | 0.02                |
| <b>2005</b>   | <b>0.5</b>            | 0.75               | 27,000                                   | 84                 | 0.05                | 0.75                | 0.05                | 26,100  | 84                 | 0.05                | 0.75                | 0.05                |
|               |                       | 1.5                | 27,000                                   | 84                 | 0.025               | 1.25                | 0.025               | 26,100  | 84                 | 0.025               | 1.25                | 0.025               |
| <b>2006</b>   | <b>0.6</b>            | 0.9                | 27,000                                   | 84                 | 0.06                | 0.9                 | 0.06                | 21,600  | 84                 | 0.06                | 0.9                 | 0.06                |
| <b>2007</b>   | <b>0.7</b>            | 1.05               | 24,750                                   | 84                 | 0.07                | 1.05                | 0.07                | 18,900  | 84                 | 0.07                | 1.05                | 0.07                |
| <b>2008</b>   | <b>0.8</b>            | 1.2                | 21,600                                   | 84                 | 0.08                | 1.2                 | 0.08                | 17,100  | 84                 | 0.08                | 1.2                 | 0.08                |
|               |                       | 2.4                | 21,600                                   | 84                 | 0.04                | 2                   | 0.04                | 17,100  | 84                 | 0.04                | 2                   | 0.04                |
| <b>2009</b>   | <b>0.9</b>            | 1.35               | 19,350                                   | 88                 | 0.09                | 1.35                | 0.09                | 14,850  | 84                 | 0.09                | 1.35                | 0.09                |
| <b>2010</b>   | <b>1</b>              | 1.5                | 18,000                                   | 88                 | 0.25                | 1.5                 | 0.1                 | 13,500  | 84                 | 0.25                | 1.5                 | 0.1                 |
|               |                       | 3                  | 18,000                                   | 88                 | 0.125               | 2.5                 | 0.05                | 13,500  | 84                 | 0.125               | 2.5                 | 0.05                |
| <b>2012</b>   | <b>1.2</b>            | 1.8                | 15,030                                   | 91                 | 0.3                 | 1.8                 | 0.12                | 11,250  | 84                 | 0.3                 | 1.8                 | 0.12                |
|               |                       | 3.6                | 15,030                                   | 91                 | 0.15                | 3                   | 0.06                | 11,250  | 84                 | 0.15                | 3                   | 0.06                |
| <b>2015</b>   | <b>1.5</b>            | 2.25               | 12,150                                   | 91                 | 0.375               | 2.25                | 0.15                | 9,000   | 84                 | 0.375               | 2.25                | 0.15                |
|               |                       | 4.5                | 12,150                                   | 91                 | 0.1875              | 3.75                | 0.075               | 9,000   | 84                 | 0.1875              | 3.75                | 0.075               |
| <b>2018</b>   | <b>1.8</b>            | 2.7                | 10,350                                   | 91                 | 0.45                | 2.7                 | 0.18                | 7,920   | 84                 | 0.45                | 2.7                 | 0.18                |
|               |                       | 5.4                | 10,350                                   | 91                 | 0.225               | 4.5                 | 0.09                | 7,920   | 84                 | 0.225               | 4.5                 | 0.09                |
| <b>2020</b>   | <b>2</b>              | 3                  | 9,900                                    | 91                 | 0.5                 | 3                   | 0.2                 | 7,650   | 84                 | 0.5                 | 3                   | 0.2                 |
|               |                       | 6                  | 9,900                                    | 91                 | 0.25                | 5                   | 0.1                 | 7,650   | 84                 | 0.25                | 5                   | 0.1                 |
| <b>2025</b>   | <b>2.5</b>            | 3.75               | 7,920                                    | 137                | 0.625               | 3.75                | 0.25                | 6,300   | 95                 | 0.625               | 3.75                | 0.25                |
| <b>2030</b>   | <b>3</b>              | 4.5                | 6,660                                    | 137                | 1.5                 | 4.5                 | 0.3                 | 5,760   | 102                | 1.5                 | 4.5                 | 0.3                 |
|               |                       | 9                  | 6,660                                    | 137                | 0.9                 | 7.5                 | 0.15                | 5,760   | 102                | 0.9                 | 7.5                 | 0.15                |
| <b>2040</b>   | <b>4</b>              | 6                  | 5,310                                    | 161                | 2                   | 6                   | 0.4                 | 4,500   | 133                | 2                   | 6                   | 0.4                 |
|               |                       | 12                 | 5,310                                    | 161                | 1.2                 | 10                  | 0.2                 | 4,500   | 133                | 1.2                 | 10                  | 0.2                 |
| <b>2050</b>   | <b>5</b>              | 7.5                | 4,770                                    | 217                | 2.5                 | 7.5                 | 0.5                 | 3,780   | 161                | 2.5                 | 7.5                 | 0.5                 |
|               |                       | 15                 | 4,770                                    | 217                | 1.5                 | 12.5                | 0.25                | 3,780   | 161                | 1.5                 | 12.5                | 0.25                |
| <b>2060</b>   | <b>6</b>              | 9                  | 3,960                                    | 214                | 3                   | 9                   | 0.6                 | 3,150   | 161                | 3                   | 9                   | 0.6                 |
|               |                       | 18                 | 3,960                                    | 214                | 1.8                 | 15                  | 0.3                 | 3,150   | 161                | 1.8                 | 15                  | 0.3                 |
| <b>2080</b>   | <b>8</b>              | 24                 | 2,970                                    | 203                | 2.4                 | 20                  | 0.4                 | 2,340   | 161                | 2.4                 | 20                  | 0.4                 |
| <b>2100</b>   | <b>10</b>             | 30                 | 2,340                                    | 193                | 3                   | 25                  | 0.5                 | 1,890   | 158                | 3                   | 25                  | 0.5                 |
| <b>2120</b>   | <b>12</b>             | 36                 | 1,980                                    | 193                | 3.6                 | 30                  | 0.6                 | 1,575   | 158                | 3.6                 | 30                  | 0.6                 |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

## Milling Conditions for C-CES-S (2 Flutes)

| WORK MATERIAL |                       |                    | PREHARDENED STEELS HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                     |                     |                     | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                     |                     |                     |
|---------------|-----------------------|--------------------|---|--------------------|---------------------|---------------------|---------------------|--|--------------------|---------------------|---------------------|---------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                            | Feed Rate (mm/min) | Slotting            | Side Milling        |                     | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | Slotting            | Side Milling        |                     |
|               |                       |                    |   |                    | a <sub>p</sub> (mm) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |  |                    | a <sub>p</sub> (mm) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |
| 2002          | 0.2                   | 0.3                | 24,000  | 21                 | 0.02                | 0.3                 | 0.02                | 24,000                                     | 18                 | 0.004               | 0.2                 | 0.01                |
|               |                       | 0.6                | 24,000  | 21                 | 0.01                | 0.5                 | 0.01                | 24,000                                     | 18                 | 0.002               | 0.4                 | 0.004               |
| 2003          | 0.3                   | 0.45               | 24,000  | 39                 | 0.03                | 0.45                | 0.03                | 17,600                                     | 18                 | 0.006               | 0.3                 | 0.015               |
|               |                       | 0.9                | 24,000  | 39                 | 0.015               | 0.75                | 0.015               | 17,600                                     | 18                 | 0.003               | 0.6                 | 0.006               |
| 2004          | 0.4                   | 0.6                | 21,600  | 42                 | 0.04                | 0.6                 | 0.04                | 13,600                                     | 18                 | 0.008               | 0.4                 | 0.02                |
|               |                       | 1.2                | 21,600  | 42                 | 0.02                | 1                   | 0.02                | 13,600                                     | 18                 | 0.004               | 0.8                 | 0.008               |
| 2005          | 0.5                   | 0.75               | 17,200  | 42                 | 0.05                | 0.75                | 0.05                | 10,400                                     | 18                 | 0.01                | 0.5                 | 0.025               |
|               |                       | 1.5                | 17,200  | 42                 | 0.025               | 1.25                | 0.025               | 10,400                                     | 18                 | 0.005               | 1                   | 0.01                |
| 2006          | 0.6                   | 0.9                | 14,400  | 42                 | 0.06                | 0.9                 | 0.06                | 8,800                                      | 18                 | 0.012               | 0.6                 | 0.03                |
| 2007          | 0.7                   | 1.05               | 12,400  | 42                 | 0.07                | 1.05                | 0.07                | 8,000                                      | 18                 | 0.014               | 0.7                 | 0.035               |
| 2008          | 0.8                   | 1.2                | 11,040  | 42                 | 0.08                | 1.2                 | 0.08                | 7,040                                      | 21                 | 0.016               | 0.8                 | 0.04                |
|               |                       | 2.4                | 11,040  | 42                 | 0.04                | 2                   | 0.04                | 7,040                                      | 21                 | 0.008               | 1.6                 | 0.016               |
| 2009          | 0.9                   | 1.35               | 9,600   | 46                 | 0.09                | 1.35                | 0.09                | 6,240                                      | 21                 | 0.018               | 0.9                 | 0.045               |
| 2010          | 1                     | 1.5                | 8,800   | 46                 | 0.25                | 1.5                 | 0.1                 | 5,680                                      | 21                 | 0.05                | 1                   | 0.05                |
|               |                       | 3                  | 8,800   | 46                 | 0.125               | 2.5                 | 0.05                | 5,680                                      | 21                 | 0.02                | 2                   | 0.02                |
| 2012          | 1.2                   | 1.8                | 7,520   | 46                 | 0.3                 | 1.8                 | 0.12                | 4,800                                      | 21                 | 0.06                | 1.2                 | 0.06                |
|               |                       | 3.6                | 7,520   | 46                 | 0.15                | 3                   | 0.06                | 4,800                                      | 21                 | 0.024               | 2.4                 | 0.024               |
| 2015          | 1.5                   | 2.25               | 6,400   | 49                 | 0.375               | 2.25                | 0.15                | 4,080                                      | 25                 | 0.075               | 1.5                 | 0.075               |
|               |                       | 4.5                | 6,400   | 49                 | 0.1875              | 3.75                | 0.075               | 4,080                                      | 25                 | 0.03                | 3                   | 0.03                |
| 2018          | 1.8                   | 2.7                | 5,600   | 49                 | 0.45                | 2.7                 | 0.18                | 3,520                                      | 25                 | 0.09                | 1.8                 | 0.09                |
|               |                       | 5.4                | 5,600   | 49                 | 0.225               | 4.5                 | 0.09                | 3,520                                      | 25                 | 0.036               | 3.6                 | 0.036               |
| 2020          | 2                     | 3                  | 5,120   | 49                 | 0.5                 | 3                   | 0.2                 | 3,200                                      | 28                 | 0.1                 | 2                   | 0.1                 |
|               |                       | 6                  | 5,120   | 49                 | 0.25                | 5                   | 0.1                 | 3,200                                      | 28                 | 0.04                | 4                   | 0.04                |
| 2025          | 2.5                   | 3.75               | 4,000   | 49                 | 0.625               | 3.75                | 0.25                | 2,560                                      | 28                 | 0.125               | 2.5                 | 0.125               |
| 2030          | 3                     | 4.5                | 3,600   | 56                 | 1.5                 | 4.5                 | 0.3                 | 2,240                                      | 32                 | 0.15                | 3                   | 0.15                |
|               |                       | 9                  | 3,600   | 56                 | 0.9                 | 7.5                 | 0.15                | 2,240                                      | 32                 | 0.06                | 6                   | 0.06                |
| 2040          | 4                     | 6                  | 2,800   | 63                 | 2                   | 6                   | 0.4                 | 1,720                                      | 35                 | 0.2                 | 4                   | 0.2                 |
|               |                       | 12                 | 2,800   | 63                 | 1.2                 | 10                  | 0.2                 | 1,720                                      | 35                 | 0.08                | 8                   | 0.08                |
| 2050          | 5                     | 7.5                | 2,360   | 63                 | 2.5                 | 7.5                 | 0.5                 | 1,480                                      | 39                 | 0.25                | 5                   | 0.25                |
|               |                       | 15                 | 2,360   | 63                 | 1.5                 | 12.5                | 0.25                | 1,480                                      | 39                 | 0.1                 | 10                  | 0.1                 |
| 2060          | 6                     | 9                  | 1,960   | 70                 | 3                   | 9                   | 0.6                 | 1,200                                      | 39                 | 0.3                 | 6                   | 0.3                 |
|               |                       | 18                 | 1,960   | 70                 | 1.8                 | 15                  | 0.3                 | 1,200                                      | 39                 | 0.12                | 12                  | 0.12                |
| 2080          | 8                     | 24                 | 1,480   | 67                 | 2.4                 | 20                  | 0.4                 | 960  | 35                 | 0.16                | 16                  | 0.16                |
| 2100          | 10                    | 30                 | 1,160   | 67                 | 3                   | 25                  | 0.5                 | 760  | 35                 | 0.2                 | 20                  | 0.2                 |
| 2120          | 12                    | 36                 | 960   | 63                 | 3.6                 | 30                  | 0.6                 | 640  | 32                 | 0.24                | 24                  | 0.24                |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

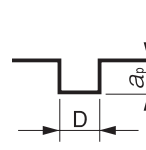
Drill

Technical Data

## Milling Conditions for C-CES-S (2 Flutes)

Milling amount for slotting (mm)  
 $D < \phi 1$

| Work Material  | Length of Cut |               |
|----------------|---------------|---------------|
|                | 2D or below   | 3D or below   |
| 45HRC or below | $a_p = 0.1D$  | $a_p = 0.05D$ |
| 45HRC or above | $a_p = 0.02D$ | $a_p = 0.01D$ |



$\phi 1 \leq D < \phi 3$

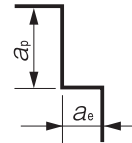
| Work Material  | Length of Cut |                |
|----------------|---------------|----------------|
|                | 2D or below   | 3D or below    |
| 45HRC or below | $a_p = 0.25D$ | $a_p = 0.125D$ |
| 45HRC or above | $a_p = 0.05D$ | $a_p = 0.02D$  |

$\phi 3 \leq D$

| Work Material  | Length of Cut |               |
|----------------|---------------|---------------|
|                | 2D or below   | 3D or below   |
| 45HRC or below | $a_p = 0.5D$  | $a_p = 0.3D$  |
| 45HRC or above | $a_p = 0.05D$ | $a_p = 0.02D$ |

Milling amount for side milling (mm)

| Work Material  | Length of Cut                |                               |
|----------------|------------------------------|-------------------------------|
|                | 2D or below                  | 3D or below                   |
| 45HRC or below | $a_p = 1.5D$<br>$a_e = 0.1D$ | $a_p = 2.5D$<br>$a_e = 0.05D$ |
| 45HRC or above | $a_p = 1D$<br>$a_e = 0.05D$  | $a_p = 2D$<br>$a_e = 0.02D$   |



D : Outside Diameter (mm)

Ex.) 2D or below : Flute Length = Diameter  $\times$  2 or below

Note:

- Recommend water soluble or oil coolant.
- Recommend oil coolant for Titanium Alloys and Heat Resistant Alloys.

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

∅3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral  
V Cutter

Spiral  
V Cutter

Drill

Drill

Technical Data

Technical Data



Size  $\phi 0.2 \sim \phi 12$

# CRN-ES2000

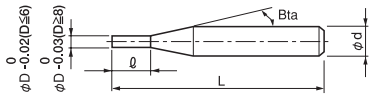


Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           |                 | ○        | ★      | ○        |                       |                 |                       |                  |                                       |

## Features

CrN COAT offers longer tool life.  
 Special geometry designed for Copper offers excellent milling performance.  
 Refer to page 232 for 4 flute CRN-ES.  
 Diameter Tolerance: 0/-0.02 ( $D \leq 6$ ), 0/-0.03 ( $D \geq 8$ )



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 26 models

Unit (mm)

| Model Number     | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|------------------|---------------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| CRN-ES 2002-0060 | 0.2                       | 0.6                  | 11°                   | 40               | 4                       | 6,100                    |
| CRN-ES 2003-0090 | 0.3                       | 0.9                  | 11°                   | 40               | 4                       | 6,100                    |
| CRN-ES 2004-0120 | 0.4                       | 1.2                  | 11°                   | 40               | 4                       | 6,100                    |
| CRN-ES 2005-0150 | 0.5                       | 1.5                  | 11°                   | 40               | 4                       | 3,200                    |
| CRN-ES 2005-0200 |                           | 2                    |                       | 45               | 4                       | 5,500                    |
| CRN-ES 2006-0180 | 0.6                       | 1.8                  | 11°                   | 40               | 4                       | 5,060                    |
| CRN-ES 2006-0240 |                           | 2.4                  |                       | 45               | 4                       | 5,500                    |
| CRN-ES 2008-0240 | 0.8                       | 2.4                  | 11°                   | 40               | 4                       | 3,200                    |
| CRN-ES 2010-0300 | 1                         | 3                    | 11°                   | 45               | 4                       | 3,200                    |
| CRN-ES 2010-0400 |                           | 4                    |                       | 50               | 4                       | 4,950                    |
| CRN-ES 2015-0450 | 1.5                       | 4.5                  | 11°                   | 45               | 4                       | 3,200                    |
| CRN-ES 2015-0600 |                           | 6                    |                       | 50               | 4                       | 4,950                    |
| CRN-ES 2020-0600 | 2                         | 6                    | 11°                   | 45               | 4                       | 3,200                    |
| CRN-ES 2020-0800 |                           | 8                    |                       | 50               | 4                       | 4,950                    |
| CRN-ES 2025-0750 | 2.5                       | 7.5                  | 11°                   | 45               | 4                       | 3,200                    |
| CRN-ES 2030-0900 | 3                         | 9                    | 11°                   | 50               | 6                       | 3,740                    |
| CRN-ES 2030-1200 |                           | 12                   |                       | 55               | 6                       | 6,050                    |
| CRN-ES 2040-1200 | 4                         | 12                   | 11°                   | 50               | 6                       | 3,960                    |
| CRN-ES 2040-1600 |                           | 16                   |                       | 55               | 6                       | 6,600                    |
| CRN-ES 2050-1500 | 5                         | 15                   | 11°                   | 55               | 6                       | 4,200                    |
| CRN-ES 2060-1800 | 6                         | 18                   | —                     | 60               | 6                       | 4,620                    |
| CRN-ES 2060-2400 |                           | 24                   |                       | 65               | 6                       | 7,480                    |
| CRN-ES 2080-2400 | 8                         | 24                   | —                     | 80               | 8                       | 8,760                    |
| CRN-ES 2100-3000 | 10                        | 30                   | —                     | 100              | 10                      | 10,900                   |
| CRN-ES 2100-4000 |                           | 40                   |                       | 100              | 10                      | 17,280                   |
| CRN-ES 2120-3600 | 12                        | 36                   | —                     | 100              | 12                      | 15,000                   |

## Milling Conditions for CRN-ES (2 Flutes)

### ◆3D flute length type

| WORK MATERIAL |                       | COPPER C1100                       |                    |                        |                         |                                    |                    |                        |
|---------------|-----------------------|------------------------------------|--------------------|------------------------|-------------------------|------------------------------------|--------------------|------------------------|
|               |                       | Side Milling                       |                    |                        |                         | Slotting                           |                    |                        |
| Model Number  | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) |
| 2002-0060     | 0.2                   | 40,000                             | 100                | 0.3                    | 0.004                   | 40,000                             | 85                 | 0.01                   |
| 2003-0090     | 0.3                   | 38,000                             | 100                | 0.45                   | 0.006                   | 38,000                             | 85                 | 0.015                  |
| 2004-0120     | 0.4                   | 35,000                             | 100                | 0.6                    | 0.008                   | 35,000                             | 85                 | 0.02                   |
| 2005-0150     | 0.5                   | 32,000                             | 120                | 0.75                   | 0.01                    | 32,000                             | 100                | 0.025                  |
| 2006-0180     | 0.6                   | 29,000                             | 150                | 0.9                    | 0.012                   | 26,000                             | 120                | 0.03                   |
| 2008-0240     | 0.8                   | 22,000                             | 180                | 1.2                    | 0.016                   | 21,000                             | 150                | 0.04                   |
| 2010-0300     | 1                     | 18,000                             | 180                | 1.5                    | 0.02                    | 16,000                             | 150                | 0.05                   |
| 2015-0450     | 1.5                   | 17,500                             | 250                | 2.25                   | 0.15                    | 11,000                             | 150                | 0.15                   |
| 2020-0600     | 2                     | 17,000                             | 340                | 3                      | 0.2                     | 7,500                              | 150                | 0.2                    |
| 2025-0750     | 2.5                   | 16,500                             | 450                | 3.75                   | 0.25                    | 6,000                              | 150                | 0.25                   |
| 2030-0900     | 3                     | 16,000                             | 630                | 4.5                    | 0.3                     | 5,000                              | 170                | 0.3                    |
| 2040-1200     | 4                     | 12,000                             | 650                | 6                      | 0.4                     | 5,000                              | 200                | 0.4                    |
| 2050-1500     | 5                     | 10,000                             | 750                | 7.5                    | 0.5                     | 5,000                              | 250                | 0.5                    |
| 2060-1800     | 6                     | 8,000                              | 800                | 9                      | 0.6                     | 4,500                              | 250                | 0.6                    |
| 2080-2400     | 8                     | 6,000                              | 700                | 12                     | 0.8                     | 4,000                              | 250                | 0.8                    |
| 2100-3000     | 10                    | 5,000                              | 600                | 15                     | 1                       | 4,000                              | 350                | 1                      |
| 2120-3600     | 12                    | 4,000                              | 500                | 18                     | 1.2                     | 4,000                              | 450                | 1.2                    |

### ◆4D flute length type

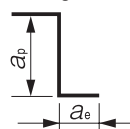
| WORK MATERIAL |                       | COPPER C1100                       |                    |                        |                         |                                    |                    |                        |
|---------------|-----------------------|------------------------------------|--------------------|------------------------|-------------------------|------------------------------------|--------------------|------------------------|
|               |                       | Side Milling                       |                    |                        |                         | Slotting                           |                    |                        |
| Model Number  | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) |
| 2005-0200     | 0.5                   | 16,000                             | 60                 | 1.25                   | 0.005                   | 16,000                             | 50                 | 0.025                  |
| 2006-0240     | 0.6                   | 14,500                             | 75                 | 1.5                    | 0.006                   | 14,500                             | 65                 | 0.03                   |
| 2010-0400     | 1                     | 9,000                              | 90                 | 2.5                    | 0.01                    | 8,000                              | 75                 | 0.05                   |
| 2015-0600     | 1.5                   | 9,000                              | 150                | 3.75                   | 0.075                   | 8,000                              | 130                | 0.15                   |
| 2020-0800     | 2                     | 5,000                              | 140                | 5                      | 0.1                     | 4,500                              | 120                | 0.2                    |
| 2030-1200     | 3                     | 3,500                              | 140                | 7.5                    | 0.15                    | 2,500                              | 85                 | 0.3                    |
| 2040-1600     | 4                     | 3,500                              | 200                | 10                     | 0.2                     | 2,500                              | 100                | 0.4                    |
| 2060-2400     | 6                     | 3,000                              | 200                | 15                     | 0.3                     | 2,500                              | 150                | 0.6                    |
| 2100-4000     | 10                    | 2,500                              | 230                | 25                     | 0.5                     | 2,000                              | 175                | 1                      |

| Milling      | Length of Cut   |  |
|--------------|---|--|
|              | 3D Flute Length Type  | 4D Flute Length Type   |
| Side Milling | $a_p$ 1.5D<br>$a_e$ 0.02D(D ≤ φ1.0)<br>$a_e$ 0.1D(D > φ1.0) | $a_p$ 2.5D<br>$a_e$ 0.01D(D ≤ φ1.0)<br>$a_e$ 0.05D(D > φ1.0) |
| Slotting     | $a_p$ 0.05D(D ≤ φ1.0)<br>$a_p$ 0.1D(D > φ1.0)               | $a_p$ 0.05D(D ≤ φ1.0)<br>$a_p$ 0.1D(D > φ1.0)                |

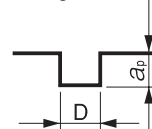
#### Note:

- Decrease both spindle speed and feed rate proportionally in case of chattering.
- Adjust the milling amount and feed rate in accordance with required precision.
- Recommend water soluble or oil coolant.
- Recommended for Pure Copper. Not suitable for Tungsten Copper.

Side Milling



Slotting



D : Outside Diameter (mm)

φ3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank Ball  
Long Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.2 \sim \phi 6$

# DCES2000



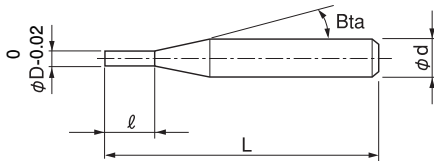
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           | ○               | ★        | ○      | ○        | ●                     |                 |                       |                  | ○                                     |

## Features

Diamond coated 2 Flute Square End Mills for Graphite Electrodes.

New Diamond coating, with a highly adhesive base layer, offers excellent wear resistance and longer tool life. Refer to page 234 for 4 flute DCES.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 8 models

Unit (mm)

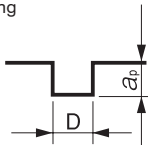
| Model Number   | Outside Diameter $\phi D$ | Length of Cut $l$ | Shank Taper Angle $Bta$ | Overall Length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|---------------------------|-------------------|-------------------------|--------------------|-------------------------|--------------------------|
| DCES 2002-0060 | 0.2                       | 0.6               | 16°                     | 45                 | 4                       | 17,000                   |
| DCES 2005-0150 | 0.5                       | 1.5               | 16°                     | 45                 | 4                       | 14,500                   |
| DCES 2010-0300 | 1                         | 3                 | 16°                     | 45                 | 4                       | 14,500                   |
| DCES 2015-0450 | 1.5                       | 4.5               | 16°                     | 45                 | 4                       | 14,500                   |
| DCES 2020-0600 | 2                         | 6                 | 16°                     | 45                 | 4                       | 14,500                   |
| DCES 2030-0900 | 3                         | 9                 | 16°                     | 45                 | 6                       | 17,000                   |
| DCES 2040-1200 | 4                         | 12                | 16°                     | 50                 | 6                       | 18,100                   |
| DCES 2060-1800 | 6                         | 18                | —                       | 60                 | 6                       | 19,300                   |



## Milling Conditions for DCES (2 Flutes)

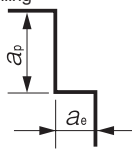
| WORK MATERIAL |                       |                    | GRAPHITE                           |                    |                        |                         |                        |
|---------------|-----------------------|--------------------|------------------------------------|--------------------|------------------------|-------------------------|------------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Side Milling           |                         | Slotting               |
|               |                       |                    |                                    |                    | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | $a_p$ Axial Depth (mm) |
| 2002-0060     | 0.2                   | 0.6                | 30,000                             | 1,000              | 0.6                    | 0.01                    | 0.006                  |
| 2005-0150     | 0.5                   | 1.5                | 30,000                             | 1,100              | 1.5                    | 0.025                   | 0.02                   |
| 2010-0300     | 1                     | 3                  | 28,000                             | 1,300              | 3                      | 0.05                    | 0.05                   |
| 2015-0450     | 1.5                   | 4.5                | 25,000                             | 1,500              | 4.5                    | 0.075                   | 0.12                   |
| 2020-0600     | 2                     | 6                  | 24,000                             | 1,800              | 6                      | 0.1                     | 0.15                   |
| 2030-0900     | 3                     | 9                  | 25,000                             | 2,600              | 9                      | 0.15                    | 0.3                    |
| 2040-1200     | 4                     | 12                 | 19,000                             | 2,000              | 12                     | 0.24                    | 0.6                    |
| 2060-1800     | 6                     | 18                 | 13,000                             | 1,500              | 18                     | 0.36                    | 1.2                    |

Slotting



D : Outside Diameter (mm)

Side Milling



Note:

- Use a milling machine dedicated for Graphite.
- Recommend air blow for Graphite.

## Other series for Graphite milling

## Square / Long Neck Square

(★ Highly Recommended ● Recommended ○ Suggested)

| Number of Flutes, Tool Type | Model Number | Appearance | Coating  | Size                   | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Hard Brittle (Non-Metallic) Materials | Page |
|-----------------------------|--------------|------------|----------|------------------------|-----------------|----------|--------|----------|-----------------------|---------------------------------------|------|
|                             |              |            |          |                        | ○               | ★        | ○      | ○        | ○                     | ●                                     |      |
| 4 flutes Square             | CGE          |            | Non-coat | $\phi 2 \sim \phi 20$  | ○               | ★        | ○      | ○        | ○                     |                                       | 236  |
| 2 flutes Square             | DCES 2000    |            | DIA      | $\phi 0.2 \sim \phi 6$ | ○               | ★        | ○      | ○        | ●                     | ○                                     | 188  |
| 4 flutes Square             | DCES 4000    |            | DIA      | $\phi 3 \sim \phi 10$  | ○               | ★        | ○      | ○        | ●                     | ○                                     | 234  |
| 2 flutes Long Neck Square   | DCLS         |            | DIA      | $\phi 0.4 \sim \phi 6$ | ○               | ★        | ○      | ○        | ●                     | ○                                     | 266  |

## Long Neck Radius

|                           |       |  |     |                      |   |   |   |   |   |   |     |
|---------------------------|-------|--|-----|----------------------|---|---|---|---|---|---|-----|
| 4 flutes Long Neck Radius | DCLRS |  | DIA | $\phi 1 \sim \phi 6$ | ○ | ★ | ○ | ○ | ● | ○ | 396 |
|---------------------------|-------|--|-----|----------------------|---|---|---|---|---|---|-----|

## Ball / Long Neck Ball / Taper Neck Ball

|                          |          |  |          |         |   |   |   |   |   |   |     |
|--------------------------|----------|--|----------|---------|---|---|---|---|---|---|-----|
| 2 flutes Ball            | CGB 2000 |  | Non-coat | R0.2~R6 | ○ | ★ | ○ | ○ | ○ |   | 440 |
| 4 flutes Ball            | CGB 4000 |  | Non-coat | R2~R10  | ○ | ★ | ○ | ○ | ○ |   | 458 |
| 2 flutes Ball            | DCB      |  | DIA      | R0.5~R6 | ○ | ★ | ○ | ○ | ● | ○ | 438 |
| 2 flutes Long Neck Ball  | DCLB     |  | DIA      | R0.2~R3 | ○ | ★ | ○ | ○ | ● | ○ | 512 |
| 2 flutes Taper Neck Ball | DCTNB    |  | DIA      | R0.5~R1 | ○ | ★ | ○ | ○ | ● | ○ | 556 |

$\phi 3$ mm Shank V Series  
 UDC-PCD Series  
 CBN Series  
 Square  
 Long Neck Square  
 Radius  
 Long Neck Radius  
 Taper Neck Radius  
 Ball / Long Shank Ball  
 Long Neck Ball  
 Taper Neck Ball  
 Taper  
 Barrel  
 Spiral V Cutter  
 Drill  
 Technical Data



Size  $\phi 0.3 \sim \phi 12$

# CPS



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           |                 |          | ○      | ●        | ★                     |                 |                       |                  |                                       |

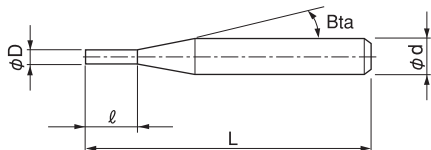
## Features

Medium length of cut design for Plastic milling.

Original flute design offers excellent surface finish.

Length of cut = outside diameter x3 (Note: outside diameter x1.5~2 is partially included).

Provides excellent milling surface for long overhang milling on Plastics.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 23 models

Unit (mm)

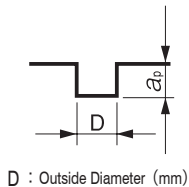
| Model Number  | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle $Bta$ | Overall Length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price $\text{¥}$ |
|---------------|---------------------------|----------------------|-------------------------|--------------------|-------------------------|-----------------------------------|
| CPS 2003      | 0.3                       | 0.9                  | 16°                     | 45                 | 4                       | 6,480                             |
| CPS 2004      | 0.4                       | 1.2                  | 16°                     | 45                 | 4                       | 7,080                             |
| CPS 2005      | 0.5                       | 1.5                  | 16°                     | 45                 | 4                       | 4,800                             |
| CPS 2006      | 0.6                       | 1.8                  | 16°                     | 45                 | 4                       | 5,520                             |
| CPS 2007      | 0.7                       | 2.1                  | 16°                     | 45                 | 4                       | 6,000                             |
| CPS 2008      | 0.8                       | 2.4                  | 16°                     | 45                 | 4                       | 5,520                             |
| CPS 2009      | 0.9                       | 2.7                  | 16°                     | 45                 | 4                       | 6,000                             |
| CPS 2010      | 1                         | 3                    | 16°                     | 50                 | 4                       | 3,840                             |
| CPS 2012      | 1.2                       | 3.6                  | 16°                     | 50                 | 4                       | 4,200                             |
| CPS 2015      | 1.5                       | 4.5                  | 16°                     | 50                 | 4                       | 4,200                             |
| CPS 2020      | 2                         | 6                    | 16°                     | 55                 | 4                       | 4,200                             |
| CPS 2025      | 2.5                       | 7.5                  | 16°                     | 55                 | 4                       | 4,300                             |
| CPS 2030      |                           | 9                    | 16°                     | 60                 | 6                       | 5,400                             |
| ○ CPS 2030SS  | 3                         | 4.5                  | —                       | 60                 | 3                       | 5,200                             |
| ○ CPS 2030SSL |                           | 6                    | —                       | 100                | 3                       | 7,800                             |
| CPS 2040      |                           | 12                   | 16°                     | 60                 | 6                       | 5,400                             |
| ○ CPS 2040SS  | 4                         | 6                    | —                       | 60                 | 4                       | 5,200                             |
| ○ CPS 2040SSL |                           | 8                    | —                       | 100                | 4                       | 9,600                             |
| CPS 2050      | 5                         | 15                   | 16°                     | 60                 | 6                       | 6,240                             |
| ○ CPS 2060    | 6                         | 18                   | —                       | 60                 | 6                       | 6,600                             |
| ○ CPS 2080    | 8                         | 24                   | —                       | 80                 | 8                       | 12,100                            |
| ○ CPS 2100    | 10                        | 30                   | —                       | 80                 | 10                      | 14,850                            |
| ○ CPS 2120    | 12                        | 36                   | —                       | 90                 | 12                      | 22,000                            |

© Straight shank type

## Milling Conditions for CPS

| WORK MATERIAL |                       |                    | ABS / MC NYLON                     |                    |                        | ACRYLIC / POLYACETAL               |                    |                        | POLYCARBONATE                      |                    |                        | GLASS FIBER REINFORCED POLYCARBONATE |                    |                        |
|---------------|-----------------------|--------------------|------------------------------------|--------------------|------------------------|------------------------------------|--------------------|------------------------|------------------------------------|--------------------|------------------------|--------------------------------------|--------------------|------------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) |
| 2003          | 0.3                   | 0.9                | 20,000                             | 320                | 0.3                    | 16,000                             | 160                | 0.3                    | 16,000                             | 130                | 0.2                    | 16,000                               | 260                | 0.2                    |
| 2004          | 0.4                   | 1.2                | 20,000                             | 400                | 0.4                    | 16,000                             | 160                | 0.4                    | 16,000                             | 130                | 0.2                    | 16,000                               | 260                | 0.3                    |
| 2005          | 0.5                   | 1.5                | 20,000                             | 480                | 0.5                    | 16,000                             | 160                | 0.5                    | 16,000                             | 130                | 0.3                    | 16,000                               | 320                | 0.4                    |
| 2006          | 0.6                   | 1.8                | 20,000                             | 600                | 0.6                    | 16,000                             | 200                | 0.5                    | 16,000                             | 130                | 0.3                    | 16,000                               | 390                | 0.5                    |
| 2007          | 0.7                   | 2.1                | 20,000                             | 720                | 0.7                    | 16,000                             | 260                | 0.6                    | 16,000                             | 160                | 0.4                    | 16,000                               | 390                | 0.6                    |
| 2008          | 0.8                   | 2.4                | 20,000                             | 800                | 0.8                    | 16,000                             | 320                | 0.7                    | 16,000                             | 160                | 0.4                    | 15,200                               | 430                | 0.6                    |
| 2009          | 0.9                   | 2.7                | 20,000                             | 880                | 0.9                    | 14,200                             | 340                | 0.8                    | 14,200                             | 170                | 0.5                    | 14,200                               | 460                | 0.7                    |
| 2010          | 1                     | 3                  | 20,000                             | 1,000              | 1                      | 14,100                             | 430                | 0.9                    | 14,100                             | 290                | 0.5                    | 14,100                               | 510                | 0.8                    |
| 2012          | 1.2                   | 3.6                | 20,000                             | 1,080              | 1.2                    | 14,100                             | 480                | 1.1                    | 14,100                             | 340                | 0.6                    | 14,100                               | 650                | 1                      |
| 2015          | 1.5                   | 4.5                | 20,000                             | 1,160              | 1.5                    | 12,800                             | 460                | 1.4                    | 12,800                             | 390                | 0.8                    | 13,200                               | 740                | 1.2                    |
| 2020          | 2                     | 6                  | 20,000                             | 1,200              | 2                      | 12,800                             | 510                | 1.6                    | 12,500                             | 430                | 0.6                    | 13,100                               | 740                | 1.4                    |
| 2025          | 2.5                   | 7.5                | 20,000                             | 1,200              | 2.5                    | 12,800                             | 570                | 2                      | 10,200                             | 450                | 0.8                    | 12,700                               | 760                | 1.8                    |
| 2030          | 3                     | 9                  | 20,000                             | 1,200              | 3                      | 12,800                             | 640                | 2.4                    | 9,600                              | 430                | 0.9                    | 10,700                               | 810                | 2.1                    |
| 2030SS        | 3                     | 4.5                | 20,000                             | 1,200              | 3                      | 12,800                             | 640                | 2.4                    | 9,600                              | 430                | 0.9                    | 10,700                               | 810                | 2.1                    |
| 2030SSL       | 3                     | 6                  | 20,000                             | 1,200              | 3                      | 12,800                             | 640                | 2.4                    | 9,600                              | 430                | 0.9                    | 10,700                               | 810                | 2.1                    |
| 2040          | 4                     | 12                 | 14,900                             | 1,200              | 4                      | 12,000                             | 600                | 3.2                    | 8,000                              | 400                | 1.2                    | 8,000                                | 770                | 2.8                    |
| 2040SS        | 4                     | 6                  | 14,900                             | 1,200              | 4                      | 12,000                             | 600                | 3.2                    | 8,000                              | 400                | 1.2                    | 8,000                                | 770                | 2.8                    |
| 2040SSL       | 4                     | 8                  | 14,900                             | 1,200              | 4                      | 12,000                             | 600                | 3.2                    | 8,000                              | 400                | 1.2                    | 8,000                                | 770                | 2.8                    |
| 2050          | 5                     | 15                 | 12,000                             | 960                | 5                      | 9,600                              | 480                | 4                      | 6,400                              | 320                | 1.5                    | 6,400                                | 620                | 3.5                    |
| 2060          | 6                     | 18                 | 10,000                             | 800                | 6                      | 8,000                              | 400                | 4.8                    | 5,400                              | 270                | 1.8                    | 5,400                                | 510                | 4.2                    |
| 2080          | 8                     | 24                 | 7,500                              | 600                | 8                      | 6,000                              | 300                | 6.4                    | 4,000                              | 200                | 2.4                    | 4,000                                | 390                | 5.6                    |
| 2100          | 10                    | 30                 | 6,000                              | 480                | 10                     | 4,800                              | 240                | 8                      | 3,200                              | 160                | 3                      | 3,200                                | 310                | 7                      |
| 2120          | 12                    | 36                 | 5,000                              | 400                | 12                     | 4,000                              | 200                | 9.6                    | 2,700                              | 140                | 3.6                    | 2,700                                | 260                | 8.4                    |

Milling Amount for Slotting (mm)



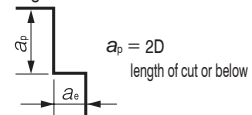
## CPS finishing conditions for side milling

Refer to the slotting parameters for spindle speed and feed rate.  
Set the milling amount as below during side milling finishing.

Milling Amount for Side Finishing (mm)

$a_e$  : 0.01 ~ 0.015D (Min 0.01 mm)

D : Outside Diameter (mm)



## Note:

- Control the radial depth ( $a_e$ ) by approximately 0.01-0.015 times of the outside diameter or set to 0.01 mm the minimum during side milling finishing.
- Increase the feed rate per flute to reduce burring on surface of softer materials.
- Chattering may occur when using a spindle with low rigidity or when milling unstable work piece. Reduce the milling amount in this case.
- Recommend to reduce the milling amount when using a machine with low spindle speed. Not recommend to reduce the feed rate.
- Adjust the milling parameters based on the overhang length.
- Recommend water soluble coolant for Aluminum Alloys and Copper.
- Recommend air blow for Plastics.
- Remove chips from the work piece to keep the milling surface quality.
- If chips clog on the tool, stop the operation and remove them accordingly.
- Straight shank type (2030SS, 2030SSL, 2040SS, 2040SSL, etc.) has smaller outside diameter than shank diameter. Prevent the shank making contact with the work piece.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.5 \sim \phi 12$

**CAS**



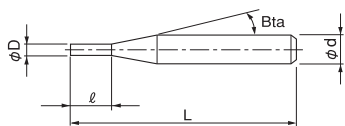
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        | ★         |                 |          | ○      |          |                       |                 |                       |                  |                                       |

**Features**

Designed especially for Aluminum milling.

45° helix angle design offers excellent cutting performance and outstanding chip evacuation.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 19 models

Unit (mm)

| Model Number  | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle $Bta$ | Overall Length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price $\yen$ |
|---------------|---------------------------|----------------------|-------------------------|--------------------|-------------------------|-------------------------------|
| CAS 2005-0075 | 0.5                       | 0.75                 | 16°                     | 45                 | 4                       | 4,030                         |
| CAS 2010-0150 | 1                         | 1.5                  | 16°                     | 45                 | 4                       | 3,480                         |
| CAS 2015-0225 | 1.5                       | 2.25                 | 16°                     | 45                 | 4                       | 3,480                         |
| CAS 2020-0300 | 2                         | 3                    | 16°                     | 45                 | 4                       | 3,480                         |
| CAS 2025-0375 | 2.5                       | 3.75                 | 16°                     | 50                 | 6                       | 4,560                         |
| CAS 2030-0450 | 3                         | 4.5                  | 16°                     | 50                 | 6                       | 4,560                         |
| CAS 2030-0900 |                           | 9                    |                         | 50                 |                         | 6,300                         |
| CAS 2040-0600 | 4                         | 6                    | 16°                     | 50                 | 6                       | 4,680                         |
| CAS 2040-1200 |                           | 12                   |                         | 50                 |                         | 6,510                         |
| CAS 2050-0750 | 5                         | 7.5                  | 16°                     | 50                 | 6                       | 5,160                         |
| CAS 2050-1500 |                           | 15                   |                         | 50                 |                         | 7,440                         |
| CAS 2060-0900 | 6                         | 9                    | —                       | 50                 | 6                       | 5,400                         |
| CAS 2060-1500 |                           | 15                   |                         | 50                 |                         | 7,560                         |
| CAS 2080-1200 | 8                         | 12                   | —                       | 80                 | 8                       | 7,680                         |
| CAS 2080-2000 |                           | 20                   |                         | 80                 |                         | 10,440                        |
| CAS 2100-1500 | 10                        | 15                   | —                       | 80                 | 10                      | 10,080                        |
| CAS 2100-2500 |                           | 25                   |                         | 80                 |                         | 13,200                        |
| CAS 2120-1800 | 12                        | 18                   | —                       | 90                 | 12                      | 14,640                        |
| CAS 2120-3000 |                           | 30                   |                         | 90                 |                         | 18,600                        |

## Milling Conditions for CAS

### ◆ Slotting

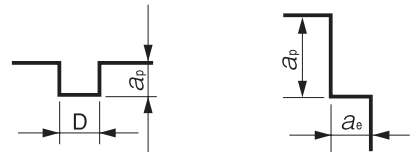
| WORK MATERIAL       |                       | ALUMINUM ALLOYS etc.<br>A5052 etc. |                    |                           |  |
|---------------------|-----------------------|------------------------------------|--------------------|---------------------------|--|
| Model Number        | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) |  |
| 2005-0075           | 0.5                   | 25,000                             | 250                | 0.75                      |  |
| 2010-0150           | 1                     | 25,000                             | 500                | 1.5                       |  |
| 2015-0225           | 1.5                   | 25,000                             | 750                | 2.25                      |  |
| 2020-0300           | 2                     | 22,000                             | 880                | 3                         |  |
| 2025-0375           | 2.5                   | 19,000                             | 950                | 3.75                      |  |
| 2030-0450           | 3                     | 16,000                             | 1,600              | 1.5                       |  |
| 2040-0600           | 4                     | 12,000                             | 1,200              | 2                         |  |
| 2050-0750           | 5                     | 9,600                              | 1,920              | 2.5                       |  |
| 2060-0900           | 6                     | 8,000                              | 1,600              | 3                         |  |
| 2080-1200           | 8                     | 6,000                              | 1,200              | 4                         |  |
| 2100-1500           | 10                    | 12,000                             | 2,400              | 5                         |  |
| 2120-1800           | 12                    | 10,000                             | 2,000              | 6                         |  |
| Milling Amount (mm) |                       | $D \leq 2.5$                       | $a_p = 1.5D$       |                           |  |
|                     |                       | $D \geq 3$                         | $a_p = 0.5D$       |                           |  |

### ◆ High speed milling

| WORK MATERIAL       |                       | ALUMINUM ALLOYS etc.<br>A5052 etc. |                    |                           |                            |
|---------------------|-----------------------|------------------------------------|--------------------|---------------------------|----------------------------|
| Model Number        | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 2030-0450           | 3                     | 20,000                             | 4,000              | 4.5                       | 0.6                        |
| 2040-0600           | 4                     | 18,200                             | 3,640              | 6                         | 0.8                        |
| 2050-0750           | 5                     | 17,000                             | 3,400              | 7.5                       | 1                          |
| 2060-0900           | 6                     | 16,000                             | 3,200              | 9                         | 1.2                        |
| 2080-1200           | 8                     | 14,400                             | 2,880              | 12                        | 1.6                        |
| 2100-1500           | 10                    | 13,200                             | 2,640              | 15                        | 2                          |
| 2120-1800           | 12                    | 12,000                             | 2,400              | 18                        | 2.4                        |
| Milling Amount (mm) |                       | $a_p = 1.5D$                       |                    |                           |                            |
|                     |                       | $a_e = 0.2D$                       |                    |                           |                            |

### ◆ Side milling

| WORK MATERIAL       |                       |                    | ALUMINUM ALLOYS etc.<br>A5052 etc. |                    |                           |                            |
|---------------------|-----------------------|--------------------|------------------------------------|--------------------|---------------------------|----------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 2005-0075           | 0.5                   | 0.75               | 25,000                             | 1,000              | 0.75                      | 0.15                       |
| 2010-0150           | 1                     | 1.5                | 25,000                             | 1,250              | 1.5                       | 0.3                        |
| 2015-0225           | 1.5                   | 2.25               | 25,000                             | 1,500              | 2.25                      | 0.45                       |
| 2020-0300           | 2                     | 3                  | 22,000                             | 1,760              | 3                         | 0.6                        |
| 2025-0375           | 2.5                   | 3.75               | 19,000                             | 1,900              | 3.75                      | 0.75                       |
| 2030-0450           | 3                     | 4.5                | 16,000                             | 3,200              | 4.5                       | 0.6                        |
| 2030-0900           |                       | 9                  |                                    |                    | 4.5                       | 0.6                        |
| 2040-0600           | 4                     | 6                  | 12,000                             | 2,400              | 6                         | 0.8                        |
| 2040-1200           |                       | 12                 |                                    |                    | 6                         | 0.8                        |
| 2050-0750           | 5                     | 7.5                | 9,600                              | 1,920              | 7.5                       | 1                          |
| 2050-1500           |                       | 15                 |                                    |                    | 7.5                       | 1                          |
| 2060-0900           | 6                     | 9                  | 8,000                              | 1,600              | 9                         | 1.2                        |
| 2060-1500           |                       | 15                 |                                    |                    | 9                         | 1.2                        |
| 2080-1200           | 8                     | 12                 | 6,000                              | 1,200              | 12                        | 1.6                        |
| 2080-2000           |                       | 20                 |                                    |                    | 12                        | 1.6                        |
| 2100-1500           | 10                    | 15                 | 4,800                              | 960                | 15                        | 2                          |
| 2100-2500           |                       | 25                 |                                    |                    | 15                        | 2                          |
| 2120-1800           | 12                    | 18                 | 4,000                              | 800                | 18                        | 2.4                        |
| 2120-3000           |                       | 30                 |                                    |                    | 18                        | 2.4                        |
| Milling Amount (mm) |                       |                    | $D \leq 2.5$                       | $a_p = 1.5D$       | $a_e = 0.3D$              |                            |
|                     |                       |                    | $D \geq 3$                         | $a_p = 1.5D$       | $a_e = 0.2D$              |                            |



D : Outside Diameter (mm)

#### Note:

- Recommend using a non-contact measuring device to avoid damaging the sharp corner.
- Recommend side milling for finishing.
- Recommend water soluble coolant.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 1 \sim \phi 20$

# C-CES4000

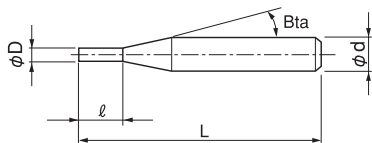


Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ○      |        |        |        |           |                 | ●        |        |          | ○                     | ○               |                       |                  |                                       |

## Features

**Broad application range from Copper and Carbon Steels up to Hardened Steels (55HRC).  
Excellent performance/quality to price ratio.  
Refer to page 166 for 2 flute C-CES.**



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece. Actual measurement is necessary when using longer length of cut than the written length.

Total 56 models

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle $B_{ta}$ | Overall Length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price $\text{¥}$ |
|-----------------|---------------------------|----------------------|----------------------------|--------------------|-------------------------|-----------------------------------|
| C-CES 4010      | 1                         | 2.5                  | 16°                        | 45                 | 4                       | 5,160                             |
| C-CES 4010-0300 |                           | 3                    |                            | 45                 | 4                       | 5,160                             |
| C-CES 4010-0400 |                           | 4                    |                            | 45                 | 4                       | 5,400                             |
| C-CES 4015      | 1.5                       | 3.75                 | 16°                        | 45                 | 4                       | 5,160                             |
| C-CES 4015-0450 |                           | 4.5                  |                            | 45                 | 4                       | 5,160                             |
| C-CES 4015-0600 |                           | 6                    |                            | 45                 | 4                       | 5,400                             |
| C-CES 4020      | 2                         | 5                    | 16°                        | 45                 | 4                       | 3,300                             |
| C-CES 4020-0600 |                           | 6                    |                            | 45                 | 4                       | 3,300                             |
| C-CES 4020-0800 |                           | 8                    |                            | 45                 | 4                       | 4,440                             |
| C-CES 4025      | 2.5                       | 6.25                 | 16°                        | 45                 | 4                       | 3,300                             |
| C-CES 4025-0750 |                           | 7.5                  |                            | 50                 | 4                       | 3,300                             |
| C-CES 4025-1000 |                           | 10                   |                            | 50                 | 4                       | 4,440                             |
| C-CES 4030-0750 | 3                         | 7.5                  | 16°                        | 45                 | 6                       | 3,420                             |
| C-CES 4030      |                           | 8                    |                            | 45                 | 6                       | 3,420                             |
| C-CES 4030-0900 |                           | 9                    |                            | 50                 | 6                       | 3,420                             |
| C-CES 4030-1200 |                           | 12                   |                            | 50                 | 6                       | 4,320                             |
| C-CES 4035      | 3.5                       | 10                   | 16°                        | 45                 | 6                       | 7,150                             |

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle $B\alpha$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|---------------------------|----------------------|-----------------------------|------------------|-------------------------|--------------------------|
| C-CES 4040      | 4                         | 11                   | 16°                         | 45               | 6                       | 3,860                    |
| C-CES 4040-1200 |                           | 12                   |                             | 60               | 6                       | 3,860                    |
| C-CES 4040-1600 |                           | 16                   |                             | 60               | 6                       | 5,160                    |
| C-CES 4045      | 4.5                       | 11                   | 16°                         | 45               | 6                       | 8,400                    |
| C-CES 4050-1250 | 5                         | 12.5                 | 16°                         | 50               | 6                       | 3,970                    |
| C-CES 4050      |                           | 13                   |                             | 50               | 6                       | 3,970                    |
| C-CES 4050-1500 |                           | 15                   |                             | 60               | 6                       | 3,970                    |
| C-CES 4050-2000 |                           | 20                   |                             | 60               | 6                       | 5,520                    |
| C-CES 4055      | 5.5                       | 13                   | 16°                         | 50               | 6                       | 8,610                    |
| C-CES 4060      | 6                         | 13                   | —                           | 50               | 6                       | 4,170                    |
| C-CES 4060-1500 |                           | 15                   |                             | 50               | 6                       | 4,170                    |
| C-CES 4060-1800 |                           | 18                   |                             | 60               | 6                       | 4,170                    |
| C-CES 4060-2400 |                           | 24                   |                             | 60               | 6                       | 6,000                    |
| C-CES 4065      | 6.5                       | 16                   | 16°                         | 60               | 8                       | 11,660                   |
| C-CES 4070      | 7                         | 16                   | 16°                         | 60               | 8                       | 10,360                   |
| C-CES 4075      | 7.5                       | 16                   | 16°                         | 60               | 8                       | 12,540                   |
| C-CES 4080      | 8                         | 19                   | —                           | 60               | 8                       | 7,090                    |
| C-CES 4080-2000 |                           | 20                   |                             | 60               | 8                       | 7,090                    |
| C-CES 4080-2400 |                           | 24                   |                             | 80               | 8                       | 7,090                    |
| C-CES 4080-3200 |                           | 32                   |                             | 80               | 8                       | 15,000                   |
| C-CES 4085      | 8.5                       | 19                   | 16°                         | 70               | 10                      | 15,180                   |
| C-CES 4090      | 9                         | 19                   | 16°                         | 70               | 10                      | 13,650                   |
| C-CES 4095      | 9.5                       | 19                   | 16°                         | 70               | 10                      | 17,160                   |
| C-CES 4100      | 10                        | 22                   | —                           | 70               | 10                      | 9,460                    |
| C-CES 4100-2500 |                           | 25                   |                             | 70               | 10                      | 9,460                    |
| C-CES 4100-3000 |                           | 30                   |                             | 90               | 10                      | 9,460                    |
| C-CES 4100-4000 |                           | 40                   |                             | 90               | 10                      | 16,560                   |
| C-CES 4105      | 10.5                      | 22                   | 16°                         | 75               | 12                      | 20,900                   |
| C-CES 4110      | 11                        | 22                   | 16°                         | 75               | 12                      | 20,900                   |
| C-CES 4115      | 11.5                      | 22                   | 16°                         | 75               | 12                      | 22,440                   |
| C-CES 4120      | 12                        | 26                   | —                           | 75               | 12                      | 11,880                   |
| C-CES 4120-3000 |                           | 30                   |                             | 75               | 12                      | 11,880                   |
| C-CES 4120-3600 |                           | 36                   |                             | 90               | 12                      | 11,880                   |
| C-CES 4120-4800 |                           | 48                   |                             | 100              | 12                      | 25,200                   |
| C-CES 4120-5000 |                           | 50                   |                             | 100              | 12                      | 25,200                   |
| C-CES 4140      | 14                        | 26                   | —                           | 80               | 12                      | 29,150                   |
| C-CES 4160      | 16                        | 32                   | —                           | 110              | 16                      | 46,200                   |
| C-CES 4180      | 18                        | 32                   | 16°                         | 110              | 20                      | 62,150                   |
| C-CES 4200      | 20                        | 38                   | —                           | 110              | 20                      | 68,200                   |

4 Flutes

ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for C-CES (4 Flutes)

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                  |                                   | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                  |                                   |
|---------------|-----------------------|--------------------|--|--------------------|----------------------------------|-----------------------------------|---|--------------------|----------------------------------|-----------------------------------|
|               |                       |                    | Side Milling                             |                    |                                  |                                   | Side Milling                                  |                    |                                  |                                   |
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>ax</sub> Axial Depth (mm) | a <sub>ar</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>ax</sub> Axial Depth (mm) | a <sub>ar</sub> Radial Depth (mm) |
| 4010          | 1                     | 2.5                | 20,000                                   | 240                | 2                                | 0.07                              | 15,000  | 215                | 2                                | 0.07                              |
|               |                       | 3                  |  |                    | 2.5                              | 0.05                              |   |                    | 2.5                              | 0.05                              |
|               |                       | 4                  |  |                    | 3.5                              | 0.02                              |   |                    | 3.5                              | 0.02                              |
| 4015          | 1.5                   | 3.75               | 13,500                                   | 245                | 3                                | 0.105                             | 10,000  | 215                | 3                                | 0.105                             |
|               |                       | 4.5                |  |                    | 3.75                             | 0.075                             |   |                    | 3.75                             | 0.075                             |
|               |                       | 6                  |  |                    | 5.25                             | 0.03                              |   |                    | 5.25                             | 0.03                              |
| 4020          | 2                     | 5                  | 11,000                                   | 245                | 4                                | 0.14                              | 8,500   | 215                | 4                                | 0.14                              |
|               |                       | 6                  |  |                    | 5                                | 0.1                               |   |                    | 5                                | 0.1                               |
|               |                       | 8                  |  |                    | 7                                | 0.04                              |   |                    | 7                                | 0.04                              |
| 4025          | 2.5                   | 6.25               | 8,800                                    | 370                | 5                                | 0.175                             | 7,000   | 245                | 5                                | 0.175                             |
|               |                       | 7.5                |  |                    | 6.25                             | 0.125                             |   |                    | 6.25                             | 0.125                             |
|               |                       | 10                 |  |                    | 8.75                             | 0.05                              |   |                    | 8.75                             | 0.05                              |
| 4030          | 3                     | 7.5                | 7,400                                    | 370                | 6                                | 0.21                              | 6,400   | 260                | 6                                | 0.21                              |
|               |                       | 8                  |  |                    | 7.5                              | 0.15                              |   |                    | 7.5                              | 0.15                              |
|               |                       | 9                  |  |                    | 7.5                              | 0.15                              |   |                    | 7.5                              | 0.15                              |
|               |                       | 12                 |  |                    | 10.5                             | 0.06                              |   |                    | 10.5                             | 0.06                              |
| 4040          | 4                     | 11                 | 5,900                                    | 435                | 10                               | 0.2                               | 5,000   | 340                | 10                               | 0.2                               |
|               |                       | 12                 |  |                    | 10                               | 0.2                               |   |                    | 10                               | 0.2                               |
|               |                       | 16                 |  |                    | 14                               | 0.08                              |   |                    | 14                               | 0.08                              |
| 4050          | 5                     | 12.5               | 5,300                                    | 590                | 10                               | 0.35                              | 4,200   | 415                | 10                               | 0.35                              |
|               |                       | 13                 |  |                    | 12.5                             | 0.25                              |   |                    | 12.5                             | 0.25                              |
|               |                       | 15                 |  |                    | 12.5                             | 0.25                              |   |                    | 12.5                             | 0.25                              |
|               |                       | 20                 |  |                    | 17.5                             | 0.1                               |   |                    | 17.5                             | 0.1                               |
| 4060          | 6                     | 13                 | 4,400                                    | 580                | 12                               | 0.42                              | 3,500   | 415                | 12                               | 0.42                              |
|               |                       | 15                 |  |                    | 12                               | 0.42                              |   |                    | 12                               | 0.42                              |
|               |                       | 18                 |  |                    | 15                               | 0.3                               |   |                    | 15                               | 0.3                               |
|               |                       | 24                 |  |                    | 21                               | 0.12                              |   |                    | 21                               | 0.12                              |
| 4080          | 8                     | 19                 | 3,300                                    | 550                | 16                               | 0.56                              | 2,600   | 415                | 16                               | 0.56                              |
|               |                       | 20                 |  |                    | 16                               | 0.56                              |   |                    | 16                               | 0.56                              |
|               |                       | 24                 |  |                    | 20                               | 0.4                               |   |                    | 20                               | 0.4                               |
|               |                       | 32                 |  |                    | 28                               | 0.16                              |   |                    | 28                               | 0.16                              |
| 4100          | 10                    | 22                 | 2,600                                    | 525                | 20                               | 0.7                               | 2,100   | 405                | 20                               | 0.7                               |
|               |                       | 25                 |  |                    | 20                               | 0.7                               |   |                    | 20                               | 0.7                               |
|               |                       | 30                 |  |                    | 25                               | 0.5                               |   |                    | 25                               | 0.5                               |
|               |                       | 40                 |  |                    | 35                               | 0.2                               |   |                    | 35                               | 0.2                               |
| 4120          | 12                    | 26                 | 2,200                                    | 525                | 24                               | 0.84                              | 1,750   | 405                | 24                               | 0.84                              |
|               |                       | 30                 |  |                    | 24                               | 0.84                              |   |                    | 24                               | 0.84                              |
|               |                       | 36                 |  |                    | 30                               | 0.6                               |   |                    | 30                               | 0.6                               |
|               |                       | 48                 |  |                    | 42                               | 0.24                              |   |                    | 42                               | 0.24                              |
|               |                       | 50                 |  |                    | 42                               | 0.24                              |   |                    | 42                               | 0.24                              |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



## Milling Conditions for C-CES (4 Flutes)

| WORK MATERIAL |                       |                    | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                    |                                     | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                    |                                     |
|---------------|-----------------------|--------------------|---|--------------------|------------------------------------|-------------------------------------|--|--------------------|------------------------------------|-------------------------------------|
|               |                       |                    | Side Milling  |                    |                                    |                                     | Side Milling                               |                    |                                    |                                     |
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>0</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>0</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) |
| 4010          | 1                     | 2.5                | 11,000  | 85                 | 2                                  | 0.07                                | 7,100                                      | 40                 | 1.5                                | 0.03                                |
|               |                       | 3                  |   |                    | 2.5                                | 0.05                                |  |                    | 2                                  | 0.02                                |
|               |                       | 4                  |   |                    | 3.5                                | 0.02                                |  |                    | 3                                  | 0.01                                |
| 4015          | 1.5                   | 3.75               | 8,000   | 90                 | 3                                  | 0.105                               | 5,100                                      | 50                 | 2.25                               | 0.045                               |
|               |                       | 4.5                |   |                    | 3.75                               | 0.075                               |  |                    | 3                                  | 0.03                                |
|               |                       | 6                  |   |                    | 5.25                               | 0.03                                |  |                    | 4.5                                | 0.015                               |
| 4020          | 2                     | 5                  | 6,400   | 90                 | 4                                  | 0.14                                | 4,000                                      | 55                 | 3                                  | 0.06                                |
|               |                       | 6                  |   |                    | 5                                  | 0.1                                 |  |                    | 4                                  | 0.04                                |
|               |                       | 8                  |   |                    | 7                                  | 0.04                                |  |                    | 6                                  | 0.02                                |
| 4025          | 2.5                   | 6.25               | 5,000   | 90                 | 5                                  | 0.175                               | 3,200                                      | 55                 | 3.75                               | 0.075                               |
|               |                       | 7.5                |   |                    | 6.25                               | 0.125                               |  |                    | 5                                  | 0.05                                |
|               |                       | 10                 |   |                    | 8.75                               | 0.05                                |  |                    | 7.5                                | 0.025                               |
| 4030          | 3                     | 7.5                | 4,500   | 105                | 6                                  | 0.21                                | 2,800                                      | 65                 | 4.5                                | 0.09                                |
|               |                       | 8                  |   |                    | 7.5                                | 0.15                                |  |                    | 6                                  | 0.06                                |
|               |                       | 9                  |   |                    | 7.5                                | 0.15                                |  |                    | 6                                  | 0.06                                |
|               |                       | 12                 |   |                    | 10.5                               | 0.06                                |  |                    | 9                                  | 0.03                                |
| 4040          | 4                     | 11                 | 3,500   | 120                | 10                                 | 0.2                                 | 2,150                                      | 70                 | 8                                  | 0.08                                |
|               |                       | 12                 |   |                    | 10                                 | 0.2                                 |  |                    | 8                                  | 0.08                                |
|               |                       | 16                 |   |                    | 14                                 | 0.08                                |  |                    | 12                                 | 0.04                                |
| 4050          | 5                     | 12.5               | 2,950   | 120                | 10                                 | 0.35                                | 1,850                                      | 75                 | 7.5                                | 0.15                                |
|               |                       | 13                 |   |                    | 12.5                               | 0.25                                |  |                    | 10                                 | 0.1                                 |
|               |                       | 15                 |   |                    | 12.5                               | 0.25                                |  |                    | 10                                 | 0.1                                 |
|               |                       | 20                 |   |                    | 17.5                               | 0.1                                 |  |                    | 15                                 | 0.05                                |
| 4060          | 6                     | 13                 | 2,450   | 130                | 12                                 | 0.42                                | 1,500                                      | 70                 | 9                                  | 0.18                                |
|               |                       | 15                 |   |                    | 12                                 | 0.42                                |  |                    | 9                                  | 0.18                                |
|               |                       | 18                 |   |                    | 15                                 | 0.3                                 |  |                    | 12                                 | 0.12                                |
|               |                       | 24                 |   |                    | 21                                 | 0.12                                |  |                    | 18                                 | 0.06                                |
| 4080          | 8                     | 19                 | 1,850   | 125                | 16                                 | 0.56                                | 1,200                                      | 70                 | 12                                 | 0.24                                |
|               |                       | 20                 |   |                    | 16                                 | 0.56                                |  |                    | 12                                 | 0.24                                |
|               |                       | 24                 |   |                    | 20                                 | 0.4                                 |  |                    | 16                                 | 0.16                                |
|               |                       | 32                 |   |                    | 28                                 | 0.16                                |  |                    | 24                                 | 0.08                                |
| 4100          | 10                    | 22                 | 1,450   | 125                | 20                                 | 0.7                                 | 950  | 65                 | 15                                 | 0.3                                 |
|               |                       | 25                 |   |                    | 20                                 | 0.7                                 |  |                    | 15                                 | 0.3                                 |
|               |                       | 30                 |   |                    | 25                                 | 0.5                                 |  |                    | 20                                 | 0.2                                 |
|               |                       | 40                 |   |                    | 35                                 | 0.2                                 |  |                    | 30                                 | 0.1                                 |
| 4120          | 12                    | 26                 | 1,200   | 120                | 24                                 | 0.84                                | 800  | 60                 | 18                                 | 0.36                                |
|               |                       | 30                 |   |                    | 24                                 | 0.84                                |  |                    | 18                                 | 0.36                                |
|               |                       | 36                 |   |                    | 30                                 | 0.6                                 |  |                    | 24                                 | 0.24                                |
|               |                       | 48                 |   |                    | 42                                 | 0.24                                |  |                    | 36                                 | 0.12                                |
|               |                       | 50                 |   |                    | 42                                 | 0.24                                |  |                    | 36                                 | 0.12                                |

4 Flutes

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for C-CES (4 Flutes)

◆High speed milling

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                  |                                   | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                  |                                   |
|---------------|-----------------------|--------------------|--|--------------------|----------------------------------|-----------------------------------|---|--------------------|----------------------------------|-----------------------------------|
|               |                       |                    | Side Milling                             |                    |                                  |                                   | Side Milling                                  |                    |                                  |                                   |
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>ax</sub> Axial Depth (mm) | a <sub>re</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>ax</sub> Axial Depth (mm) | a <sub>re</sub> Radial Depth (mm) |
| 4030          | 3                     | 7.5                | 30,000                                   | 1,500              | 6                                | 0.21                              | 26,500  | 1,075              | 6                                | 0.21                              |
|               |                       | 8                  |  |                    | 7.5                              | 0.15                              |   |                    | 7.5                              | 0.15                              |
|               |                       | 9                  |  |                    | 7.5                              | 0.15                              |   |                    | 7.5                              | 0.15                              |
|               |                       | 12                 |  |                    | 10.5                             | 0.06                              |   |                    | 10.5                             | 0.06                              |
| 4040          | 4                     | 11                 | 23,800                                   | 1,755              | 10                               | 0.2                               | 19,800  | 1,345              | 10                               | 0.2                               |
|               |                       | 12                 |  |                    | 10                               | 0.2                               |   |                    | 10                               | 0.2                               |
|               |                       | 16                 |  |                    | 14                               | 0.08                              |   |                    | 14                               | 0.08                              |
| 4050          | 5                     | 12.5               | 19,000                                   | 2,115              | 10                               | 0.35                              | 15,800  | 1,560              | 10                               | 0.35                              |
|               |                       | 13                 |  |                    | 12.5                             | 0.25                              |   |                    | 12.5                             | 0.25                              |
|               |                       | 15                 |  |                    | 12.5                             | 0.25                              |   |                    | 12.5                             | 0.25                              |
|               |                       | 20                 |  |                    | 17.5                             | 0.1                               |   |                    | 17.5                             | 0.1                               |
| 4060          | 6                     | 13                 | 15,900                                   | 2,095              | 12                               | 0.42                              | 13,200  | 1,565              | 12                               | 0.42                              |
|               |                       | 15                 |  |                    | 12                               | 0.42                              |   |                    | 12                               | 0.42                              |
|               |                       | 18                 |  |                    | 15                               | 0.3                               |   |                    | 15                               | 0.3                               |
|               |                       | 24                 |  |                    | 21                               | 0.12                              |   |                    | 21                               | 0.12                              |
| 4080          | 8                     | 19                 | 11,900                                   | 1,985              | 16                               | 0.56                              | 9,900   | 1,580              | 16                               | 0.56                              |
|               |                       | 20                 |  |                    | 16                               | 0.56                              |   |                    | 16                               | 0.56                              |
|               |                       | 24                 |  |                    | 20                               | 0.4                               |   |                    | 20                               | 0.4                               |
|               |                       | 32                 |  |                    | 28                               | 0.16                              |   |                    | 28                               | 0.16                              |
| 4100          | 10                    | 22                 | 9,500                                    | 1,920              | 20                               | 0.7                               | 7,900   | 1,525              | 20                               | 0.7                               |
|               |                       | 25                 |  |                    | 20                               | 0.7                               |   |                    | 20                               | 0.7                               |
|               |                       | 30                 |  |                    | 25                               | 0.5                               |   |                    | 25                               | 0.5                               |
|               |                       | 40                 |  |                    | 35                               | 0.2                               |   |                    | 35                               | 0.2                               |
| 4120          | 12                    | 26                 | 7,900                                    | 1,885              | 24                               | 0.84                              | 6,600   | 1,525              | 24                               | 0.84                              |
|               |                       | 30                 |  |                    | 24                               | 0.84                              |   |                    | 24                               | 0.84                              |
|               |                       | 36                 |  |                    | 30                               | 0.6                               |   |                    | 30                               | 0.6                               |
|               |                       | 48                 |  |                    | 42                               | 0.24                              |   |                    | 42                               | 0.24                              |
|               |                       | 50                 |  |                    | 42                               | 0.24                              |   |                    | 42                               | 0.24                              |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

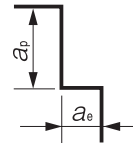
## Milling Conditions for C-CES (4 Flutes)

4 Flutes

| WORK MATERIAL |                       |                    | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                    |                                     | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                    |                                     |
|---------------|-----------------------|--------------------|---|--------------------|------------------------------------|-------------------------------------|--|--------------------|------------------------------------|-------------------------------------|
|               |                       |                    | Side Milling  |                    |                                    |                                     | Side Milling                               |                    |                                    |                                     |
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) |
| 4030          | 3                     | 7.5                | 21,200  | 495                | 6                                  | 0.21                                | 15,800                                     | 365                | 4.5                                | 0.09                                |
|               |                       | 8                  |   |                    | 7.5                                | 0.15                                |  |                    | 6                                  | 0.06                                |
|               |                       | 9                  |   |                    | 7.5                                | 0.15                                |  |                    | 6                                  | 0.06                                |
|               |                       | 12                 |   |                    | 10.5                               | 0.06                                |  |                    | 9                                  | 0.03                                |
| 4040          | 4                     | 11                 | 15,800  | 540                | 10                                 | 0.2                                 | 11,900                                     | 385                | 8                                  | 0.08                                |
|               |                       | 12                 |   |                    | 10                                 | 0.2                                 |  |                    | 8                                  | 0.08                                |
|               |                       | 16                 |   |                    | 14                                 | 0.08                                |  |                    | 12                                 | 0.04                                |
| 4050          | 5                     | 12.5               | 12,700  | 515                | 10                                 | 0.35                                | 9,500                                      | 385                | 7.5                                | 0.15                                |
|               |                       | 13                 |   |                    | 12.5                               | 0.25                                |  |                    | 10                                 | 0.1                                 |
|               |                       | 15                 |   |                    | 12.5                               | 0.25                                |  |                    | 10                                 | 0.1                                 |
|               |                       | 20                 |   |                    | 17.5                               | 0.1                                 |  |                    | 15                                 | 0.05                                |
| 4060          | 6                     | 13                 | 10,600  | 560                | 12                                 | 0.42                                | 7,900                                      | 370                | 9                                  | 0.18                                |
|               |                       | 15                 |   |                    | 12                                 | 0.42                                |  |                    | 9                                  | 0.18                                |
|               |                       | 18                 |   |                    | 15                                 | 0.3                                 |  |                    | 12                                 | 0.12                                |
|               |                       | 24                 |   |                    | 21                                 | 0.12                                |  |                    | 18                                 | 0.06                                |
| 4080          | 8                     | 19                 | 7,900   | 535                | 16                                 | 0.56                                | 5,900                                      | 345                | 12                                 | 0.24                                |
|               |                       | 20                 |   |                    | 16                                 | 0.56                                |  |                    | 12                                 | 0.24                                |
|               |                       | 24                 |   |                    | 20                                 | 0.4                                 |  |                    | 16                                 | 0.16                                |
|               |                       | 32                 |   |                    | 28                                 | 0.16                                |  |                    | 24                                 | 0.08                                |
| 4100          | 10                    | 22                 | 6,300   | 545                | 20                                 | 0.7                                 | 4,700                                      | 320                | 15                                 | 0.3                                 |
|               |                       | 25                 |   |                    | 20                                 | 0.7                                 |  |                    | 15                                 | 0.3                                 |
|               |                       | 30                 |   |                    | 25                                 | 0.5                                 |  |                    | 20                                 | 0.2                                 |
|               |                       | 40                 |   |                    | 35                                 | 0.2                                 |  |                    | 30                                 | 0.1                                 |
| 4120          | 12                    | 26                 | 5,300   | 530                | 24                                 | 0.84                                | 3,900                                      | 295                | 18                                 | 0.36                                |
|               |                       | 30                 |   |                    | 24                                 | 0.84                                |  |                    | 18                                 | 0.36                                |
|               |                       | 36                 |   |                    | 30                                 | 0.6                                 |  |                    | 24                                 | 0.24                                |
|               |                       | 48                 |   |                    | 42                                 | 0.24                                |  |                    | 36                                 | 0.12                                |
|               |                       | 50                 |   |                    | 42                                 | 0.24                                |  |                    | 36                                 | 0.12                                |

Milling amount (mm)

| Work Material  | Length of Cut  | 2.5D or below                                 | 3D or below                                 | 4D or above                                   |
|----------------|----------------|---|---|---|
|                | 45HRC or below |   | a <sub>p</sub> =2D<br>a <sub>e</sub> =0.07D | a <sub>p</sub> =2.5D<br>a <sub>e</sub> =0.05D |
| 45HRC or above |                | a <sub>p</sub> =1.5D<br>a <sub>e</sub> =0.03D | a <sub>p</sub> =2D<br>a <sub>e</sub> =0.02D | a <sub>p</sub> =3D<br>a <sub>e</sub> =0.01D   |



D : Outside Diameter (mm)

Ex.) 2D or below : Flute Length = Diameter × 2 or below

Note:

- Recommend water soluble or oil coolant.
- Recommend oil coolant for Titanium Alloys and Heat Resistant Alloys.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball  
Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 1 \sim \phi 12$

# C-CES4000S

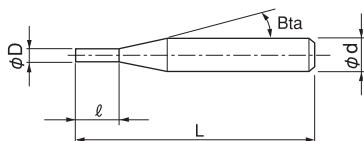


Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ○      |        |        |        | ○         |                 |          | ●      |          |                       | ○               | ○                     |                  |                                       |

## Features

4 flute C-CES with a sharp corner design.  
 Broad application range from Copper and Carbon Steels up to Hardened Steels (55HRC).  
 Excellent performance / quality to price ratio.  
 Refer to page 180 for 2 flute C-CES-S.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 11 models

Unit (mm)

| Model Number | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle $Bta$ | Overall Length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|---------------------------|----------------------|-------------------------|--------------------|-------------------------|--------------------------|
| C-CES 4010S  | 1                         | 2.5                  | 16°                     | 45                 | 4                       | 5,160                    |
| C-CES 4015S  | 1.5                       | 3.75                 | 16°                     | 45                 | 4                       | 5,160                    |
| C-CES 4020S  | 2                         | 6                    | 16°                     | 45                 | 4                       | 3,300                    |
| C-CES 4025S  | 2.5                       | 6.25                 | 16°                     | 45                 | 4                       | 3,300                    |
| C-CES 4030S  | 3                         | 8                    | 16°                     | 45                 | 6                       | 3,420                    |
| C-CES 4040S  | 4                         | 11                   | 16°                     | 45                 | 6                       | 3,860                    |
| C-CES 4050S  | 5                         | 13                   | 16°                     | 50                 | 6                       | 3,970                    |
| C-CES 4060S  | 6                         | 13                   | —                       | 50                 | 6                       | 4,170                    |
| C-CES 4080S  | 8                         | 19                   | —                       | 60                 | 8                       | 7,090                    |
| C-CES 4100S  | 10                        | 22                   | —                       | 70                 | 10                      | 9,460                    |
| C-CES 4120S  | 12                        | 26                   | —                       | 75                 | 12                      | 11,880                   |

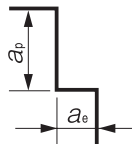
## Milling Conditions for C-CES-S (4 Flutes)

| WORK MATERIAL |                       | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                    |                                     | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                    |                                     |
|---------------|-----------------------|--|--------------------|------------------------------------|-------------------------------------|---|--------------------|------------------------------------|-------------------------------------|
|               |                       | Side Milling                             |                    |                                    |                                     | Side Milling                                  |                    |                                    |                                     |
| Model Number  | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) |
| 4010S         | 1                     | 20,000                                   | 170                | 2                                  | 0.07                                | 13,700  | 150                | 2                                  | 0.07                                |
| 4015S         | 1.5                   | 13,400                                   | 190                | 3                                  | 0.105                               | 9,100   | 160                | 3                                  | 0.105                               |
| 4020S         | 2                     | 11,600                                   | 200                | 4                                  | 0.14                                | 5,600   | 170                | 4                                  | 0.14                                |
| 4025S         | 2.5                   | 9,300                                    | 300                | 5                                  | 0.175                               | 4,200   | 190                | 5                                  | 0.175                               |
| 4030S         | 3                     | 8,800                                    | 340                | 6                                  | 0.21                                | 6,700   | 210                | 6                                  | 0.21                                |
| 4040S         | 4                     | 6,600                                    | 370                | 8                                  | 0.28                                | 5,000   | 270                | 8                                  | 0.28                                |
| 4050S         | 5                     | 5,300                                    | 450                | 10                                 | 0.35                                | 4,000   | 320                | 10                                 | 0.35                                |
| 4060S         | 6                     | 4,400                                    | 450                | 12                                 | 0.42                                | 3,300   | 320                | 12                                 | 0.42                                |
| 4080S         | 8                     | 3,300                                    | 420                | 16                                 | 0.56                                | 2,500   | 300                | 16                                 | 0.56                                |
| 4100S         | 10                    | 2,650                                    | 410                | 20                                 | 0.7                                 | 2,000   | 300                | 20                                 | 0.7                                 |
| 4120S         | 12                    | 2,200                                    | 400                | 24                                 | 0.84                                | 1,700   | 300                | 24                                 | 0.84                                |

| WORK MATERIAL |                       | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                    |                                     | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                    |                                     |
|---------------|-----------------------|---|--------------------|------------------------------------|-------------------------------------|--|--------------------|------------------------------------|-------------------------------------|
|               |                       | Side Milling  |                    |                                    |                                     | Side Milling                               |                    |                                    |                                     |
| Model Number  | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) |
| 4010S         | 1                     | 7,300   | 55                 | 2                                  | 0.07                                | 1,600                                      | 15                 | 1.5                                | 0.03                                |
| 4015S         | 1.5                   | 4,900   | 60                 | 3                                  | 0.105                               | 1,100                                      | 15                 | 2.25                               | 0.045                               |
| 4020S         | 2                     | 5,300   | 65                 | 4                                  | 0.14                                | 2,400                                      | 30                 | 3                                  | 0.06                                |
| 4025S         | 2.5                   | 4,200   | 70                 | 5                                  | 0.175                               | 1,900                                      | 35                 | 3.75                               | 0.075                               |
| 4030S         | 3                     | 4,600   | 90                 | 6                                  | 0.21                                | 2,700                                      | 50                 | 4.5                                | 0.09                                |
| 4040S         | 4                     | 3,400   | 100                | 8                                  | 0.28                                | 2,000                                      | 55                 | 6                                  | 0.12                                |
| 4050S         | 5                     | 2,700   | 110                | 10                                 | 0.35                                | 1,600                                      | 60                 | 7.5                                | 0.15                                |
| 4060S         | 6                     | 2,300   | 110                | 12                                 | 0.42                                | 1,300                                      | 60                 | 9                                  | 0.18                                |
| 4080S         | 8                     | 1,700   | 100                | 16                                 | 0.56                                | 1,000                                      | 50                 | 12                                 | 0.24                                |
| 4100S         | 10                    | 1,400   | 100                | 20                                 | 0.7                                 | 800  | 50                 | 15                                 | 0.3                                 |
| 4120S         | 12                    | 1,150   | 90                 | 24                                 | 0.84                                | 700  | 45                 | 18                                 | 0.36                                |

Milling Amount for side milling (mm)

|                |   |
|----------------|---|
| 45HRC or below | a <sub>p</sub> =2D<br>a <sub>e</sub> =0.07D   |
| 45HRC or above | a <sub>p</sub> =1.5D<br>a <sub>e</sub> =0.03D |



D : Outside Diameter (mm)

Note:

- Recommend water soluble or oil coolant.
- Recommend oil coolant for Titanium Alloys and Heat Resistant Alloys.

4 Flutes

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

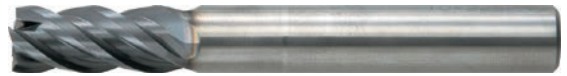
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 1 \sim \phi 20$

**CZS**

Super  
MG

UT  
COAT

40°

Flatland

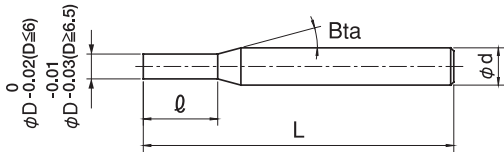
Shank Dia  
0/-0.005

Variable  
Pitch

Patented in Japan, China, Taiwan, Korea, Germany, Switzerland, and Liechtenstein

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ○      |        |        |        | ○         | ○               |          | ●      |          |                       | ○               | ○                     |                  |                                       |



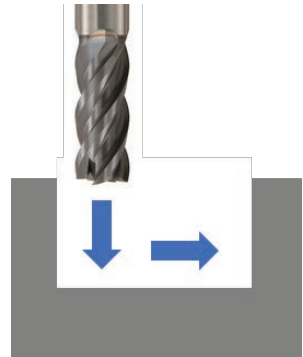
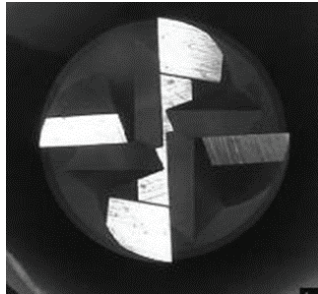
The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece. Actual measurement is necessary when using longer length of cut than the written length.

**Drilling and Milling in a Single Tool! 1/2 Cycle Time!**



**Drilling and Milling in a Single Tool**

**The unique design of the bottom edge offers the drilling process with 4 flutes**



- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Total 89 models

Unit (mm)

| Model Number  | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|---------------|---------------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| CZS 4010-0150 | 1                         | 1.5                  | 16°                   | 50               | 4                       | 6,900                    |
| CZS 4010-0250 |                           | 2.5                  |                       | 50               |                         |                          |
| CZS 4011-0250 | 1.1                       | 2.5                  | 16°                   | 50               | 4                       | 8,630                    |
| CZS 4012-0250 | 1.2                       | 2.5                  | 16°                   | 50               | 4                       | 8,630                    |
| CZS 4013-0300 | 1.3                       | 3                    | 16°                   | 50               | 4                       | 8,630                    |
| CZS 4014-0300 | 1.4                       | 3                    | 16°                   | 50               | 4                       | 8,630                    |
| CZS 4015-0225 | 1.5                       | 2.25                 | 16°                   | 50               | 4                       | 6,900                    |
| CZS 4015-0400 |                           | 4                    |                       | 50               |                         |                          |
| CZS 4016-0400 | 1.6                       | 4                    | 16°                   | 50               | 4                       | 8,630                    |
| CZS 4017-0400 | 1.7                       | 4                    | 16°                   | 50               | 4                       | 8,630                    |
| CZS 4018-0400 | 1.8                       | 4                    | 16°                   | 50               | 4                       | 8,630                    |
| CZS 4019-0400 | 1.9                       | 4                    | 16°                   | 50               | 4                       | 8,630                    |
| CZS 4020-0300 | 2                         | 3                    | 16°                   | 50               | 4                       | 6,300                    |
| CZS 4020-0600 |                           | 6                    |                       | 50               |                         |                          |
| CZS 4021-0600 | 2.1                       | 6                    | 16°                   | 50               | 4                       | 7,870                    |
| CZS 4022-0600 | 2.2                       | 6                    | 16°                   | 50               | 4                       | 7,870                    |
| CZS 4023-0600 | 2.3                       | 6                    | 16°                   | 50               | 4                       | 7,870                    |
| CZS 4024-0600 | 2.4                       | 6                    | 16°                   | 50               | 4                       | 7,870                    |
| CZS 4025-0375 | 2.5                       | 3.75                 | 16°                   | 50               | 4                       | 6,300                    |
| CZS 4025-0800 |                           | 8                    |                       | 50               |                         |                          |
| CZS 4026-0800 | 2.6                       | 8                    | 16°                   | 50               | 4                       | 7,870                    |
| CZS 4027-0800 | 2.7                       | 8                    | 16°                   | 50               | 4                       | 7,870                    |
| CZS 4028-0800 | 2.8                       | 8                    | 16°                   | 50               | 4                       | 7,870                    |
| CZS 4029-0800 | 2.9                       | 8                    | 16°                   | 50               | 4                       | 7,870                    |
| CZS 4030-0450 | 3                         | 4.5                  | 16°                   | 60               | 6                       | 7,500                    |
| CZS 4030-0800 |                           | 8                    |                       | 60               |                         |                          |
| CZS 4031-0800 | 3.1                       | 8                    | 16°                   | 60               | 6                       | 9,400                    |
| CZS 4032-0800 | 3.2                       | 8                    | 16°                   | 60               | 6                       | 9,400                    |
| CZS 4033-0800 | 3.3                       | 8                    | 16°                   | 60               | 6                       | 9,400                    |
| CZS 4034-0800 | 3.4                       | 8                    | 16°                   | 60               | 6                       | 9,400                    |
| CZS 4035-1000 | 3.5                       | 10                   | 16°                   | 60               | 6                       | 8,700                    |
| CZS 4036-1000 | 3.6                       | 10                   | 16°                   | 60               | 6                       | 9,400                    |
| CZS 4037-1000 | 3.7                       | 10                   | 16°                   | 60               | 6                       | 9,400                    |
| CZS 4038-1000 | 3.8                       | 10                   | 16°                   | 60               | 6                       | 9,400                    |

4 Flutes

ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank Ball

Ball

Long Neck  
BallTaper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Next Page →

Unit (mm)

| Model Number         | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------------|---------------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| <b>CZS 4039-1000</b> | 3.9                       | 10                   | 16°                   | 60               | 6                       | 9,400                    |
| <b>CZS 4040-0600</b> | 4                         | 6                    | 16°                   | 60               | 6                       | 7,800                    |
| <b>CZS 4040-1100</b> |                           | 11                   |                       | 60               | 6                       | 7,800                    |
| <b>CZS 4041-1100</b> | 4.1                       | 11                   | 16°                   | 60               | 6                       | 9,750                    |
| <b>CZS 4042-1100</b> | 4.2                       | 11                   | 16°                   | 60               | 6                       | 9,750                    |
| <b>CZS 4043-1100</b> | 4.3                       | 11                   | 16°                   | 60               | 6                       | 9,750                    |
| <b>CZS 4044-1100</b> | 4.4                       | 11                   | 16°                   | 60               | 6                       | 9,750                    |
| <b>CZS 4045-1100</b> | 4.5                       | 11                   | 16°                   | 60               | 6                       | 9,300                    |
| <b>CZS 4046-1100</b> | 4.6                       | 11                   | 16°                   | 60               | 6                       | 9,750                    |
| <b>CZS 4047-1100</b> | 4.7                       | 11                   | 16°                   | 60               | 6                       | 9,750                    |
| <b>CZS 4048-1100</b> | 4.8                       | 11                   | 16°                   | 60               | 6                       | 9,750                    |
| <b>CZS 4049-1100</b> | 4.9                       | 11                   | 16°                   | 60               | 6                       | 9,750                    |
| <b>CZS 4050-0750</b> | 5                         | 7.5                  | 16°                   | 60               | 6                       | 8,400                    |
| <b>CZS 4050-1300</b> |                           | 13                   |                       | 60               | 6                       | 8,400                    |
| <b>CZS 4051-1300</b> | 5.1                       | 13                   | 16°                   | 60               | 6                       | 10,500                   |
| <b>CZS 4052-1300</b> | 5.2                       | 13                   | 16°                   | 60               | 6                       | 10,500                   |
| <b>CZS 4053-1300</b> | 5.3                       | 13                   | 16°                   | 60               | 6                       | 10,500                   |
| <b>CZS 4054-1300</b> | 5.4                       | 13                   | 16°                   | 60               | 6                       | 10,500                   |
| <b>CZS 4055-1300</b> | 5.5                       | 13                   | 16°                   | 60               | 6                       | 9,600                    |
| <b>CZS 4056-1300</b> | 5.6                       | 13                   | 16°                   | 60               | 6                       | 10,500                   |
| <b>CZS 4057-1300</b> | 5.7                       | 13                   | 16°                   | 60               | 6                       | 10,500                   |
| <b>CZS 4058-1300</b> | 5.8                       | 13                   | 16°                   | 60               | 6                       | 10,500                   |
| <b>CZS 4059-1300</b> | 5.9                       | 13                   | 16°                   | 60               | 6                       | 10,500                   |
| <b>CZS 4060-0900</b> | 6                         | 9                    | —                     | 60               | 6                       | 8,700                    |
| <b>CZS 4060-1300</b> |                           | 13                   |                       | 60               | 6                       | 8,700                    |
| <b>CZS 4060-1800</b> |                           | 18                   |                       | 60               | 6                       | 9,600                    |
| <b>CZS 4065-1600</b> | 6.5                       | 16                   | 16°                   | 70               | 8                       | 12,600                   |
| <b>CZS 4070-1050</b> | 7                         | 10.5                 | 16°                   | 70               | 8                       | 11,300                   |
| <b>CZS 4070-1600</b> |                           | 16                   |                       | 70               | 8                       | 11,300                   |
| <b>CZS 4070-2100</b> |                           | 21                   |                       | 70               | 8                       | 12,500                   |
| <b>CZS 4075-1600</b> | 7.5                       | 16                   | 16°                   | 70               | 8                       | 12,600                   |
| <b>CZS 4080-1200</b> | 8                         | 12                   | —                     | 70               | 8                       | 11,300                   |
| <b>CZS 4080-1900</b> |                           | 19                   |                       | 70               | 8                       | 11,300                   |
| <b>CZS 4080-2400</b> |                           | 24                   |                       | 70               | 8                       | 12,500                   |

Next Page ➡

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square**
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Unit (mm)

| Model Number  | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|---------------|---------------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| CZS 4085-1900 | 8.5                       | 19                   | 16°                   | 80               | 10                      | 14,600                   |
| CZS 4090-1350 | 9                         | 13.5                 | 16°                   | 80               | 10                      | 13,200                   |
| CZS 4090-1900 |                           | 19                   |                       | 80               | 10                      | 13,200                   |
| CZS 4090-2700 |                           | 27                   |                       | 80               | 10                      | 16,700                   |
| CZS 4095-1900 |                           | 19                   |                       | 80               | 10                      | 14,600                   |
| CZS 4100-1500 | 10                        | 15                   | —                     | 80               | 10                      | 13,200                   |
| CZS 4100-2200 |                           | 22                   |                       | 80               | 10                      | 13,200                   |
| CZS 4100-3000 |                           | 30                   |                       | 80               | 10                      | 14,600                   |
| CZS 4105-2200 | 10.5                      | 22                   | 16°                   | 100              | 12                      | 21,000                   |
| CZS 4110-1650 | 11                        | 16.5                 | 16°                   | 100              | 12                      | 19,300                   |
| CZS 4110-2200 |                           | 22                   |                       | 100              | 12                      | 19,300                   |
| CZS 4110-3300 |                           | 33                   |                       | 100              | 12                      | 23,000                   |
| CZS 4115-2200 | 11.5                      | 22                   | 16°                   | 100              | 12                      | 21,000                   |
| CZS 4120-1800 | 12                        | 18                   | —                     | 100              | 12                      | 19,300                   |
| CZS 4120-2600 |                           | 26                   |                       | 100              | 12                      | 19,300                   |
| CZS 4120-3600 |                           | 36                   |                       | 100              | 12                      | 21,300                   |
| CZS 4130-2600 | 13                        | 26                   | —                     | 110              | 12                      | 26,500                   |
| CZS 4160-2400 | 16                        | 24                   | —                     | 110              | 16                      | 54,200                   |
| CZS 4160-3200 |                           | 32                   |                       | 110              | 16                      | 57,000                   |
| CZS 4200-3000 | 20                        | 30                   | —                     | 125              | 20                      | 79,800                   |
| CZS 4200-4000 |                           | 40                   |                       | 125              | 20                      | 84,000                   |

4 Flutes

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral  
V Cutter

Spiral  
V Cutter

Drill

Drill

Technical Data

Technical Data

CZS Series  
S50C  
Milling Video



## Milling Conditions for CZS

### ◆1.5D flute length type

| WORK MATERIAL       |                       |                    | CARBON STEELS<br>S45C / S50C<br>Annealed Materials<br>(~225HB) |   |                                   |  |                                 |  |                                 |                                  |
|---------------------|-----------------------|--------------------|--|---|-----------------------------------|--|---------------------------------|--|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                             | Vertical                                  |                                   | Slotting                                       |                                 | Side Milling   |                                 |                                  |
|                     |                       |                    |  | Feed Rate (mm/min)                        | a <sub>p</sub> Axial Depth (mm)   | Feed Rate (mm/min)                             | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)   | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-0150           | 1                     | 1.5                | 18,000   | 150                                       | 1                                 | 200  | 1                               | 1,200  | 1.5                             | 0.1※                             |
| 4015-0225           | 1.5                   | 2.25               | 16,000   | 200                                       | 1.5                               | 550  | 1.5                             | 1,800  | 2.25                            | 0.15※                            |
| 4020-0300           | 2                     | 3                  | 12,000   | 200                                       | 2                                 | 550  | 2                               | 1,800  | 3                               | 0.2※                             |
| 4025-0375           | 2.5                   | 3.75               | 10,000   | 300                                       | 2.5                               | 950  | 2.5                             | 2,400  | 3.75                            | 0.25※                            |
| 4030-0450           | 3                     | 4.5                | 8,500  | 300                                       | 3                                 | 950  | 3                               | 2,400  | 4.5                             | 0.3※                             |
| 4040-0600           | 4                     | 6                  | 7,200  | 300                                       | 4                                 | 950  | 4                               | 1,350  | 6                               | 0.8                              |
| 4050-0750           | 5                     | 7.5                | 6,000  | 300                                       | 5                                 | 1,000  | 5                               | 1,500  | 7.5                             | 1                                |
| 4060-0900           | 6                     | 9                  | 5,000  | 300                                       | 6                                 | 1,000  | 6                               | 1,600  | 9                               | 1.2                              |
| 4070-1050           | 7                     | 10.5               | 4,200  | 300                                       | 7                                 | 1,000  | 7                               | 1,500  | 10.5                            | 1.4                              |
| 4080-1200           | 8                     | 12                 | 3,500  | 300                                       | 8                                 | 950  | 8                               | 1,400  | 12                              | 1.6                              |
| 4090-1350           | 9                     | 13.5               | 2,900  | 300                                       | 9                                 | 950  | 9                               | 1,300  | 13.5                            | 1.8                              |
| 4100-1500           | 10                    | 15                 | 2,300  | 300                                       | 10                                | 900  | 10                              | 1,200  | 15                              | 2                                |
| 4110-1650           | 11                    | 16.5               | 2,050  | 280                                       | 11                                | 900  | 11                              | 1,150  | 16.5                            | 2.2                              |
| 4120-1800           | 12                    | 18                 | 1,850  | 260                                       | 12                                | 850  | 12                              | 1,100  | 18                              | 2.4                              |
| 4160-2400           | 16                    | 24                 | 1,380  | 150                                       | Step Amount: 1.6<br>Max depth 10※ | 830  | 8※                              | 550  | 24                              | 3.2                              |
| 4200-3000           | 20                    | 30                 | 1,000  | 150                                       | Step Amount: 2<br>Max depth 10※   | 830  | 10※                             | 500  | 30                              | 4                                |
| Milling Amount (mm) |                       |                    |  | ※ Depth: 1D<br>Depth: 0.1D<br>(Max 10 mm) |                                   | ※ a <sub>p</sub> : 1D<br>a <sub>p</sub> : 0.5D |                                 | a <sub>p</sub> : Length of Cut<br>a <sub>e</sub> : 0.2D<br>※ a <sub>e</sub> : 0.1D |                                 |                                  |

| WORK MATERIAL       |                       |                    | ALLOY STEELS<br>SK / SCM<br>Annealed Materials<br>(225~325HB) |  |                                    |  |                                 |  |                                 |                                  |
|---------------------|-----------------------|--------------------|---|--|------------------------------------|--|---------------------------------|--|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                            | Vertical   |                                    | Slotting                                       |                                 | Side Milling   |                                 |                                  |
|                     |                       |                    |   | Feed Rate (mm/min)                                       | a <sub>p</sub> Axial Depth (mm)    | Feed Rate (mm/min)                             | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)   | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-0150           | 1                     | 1.5                | 14,500  | 50   | 1                                  | 150  | 1                               | 900  | 1.5                             | 0.1※                             |
| 4015-0225           | 1.5                   | 2.25               | 13,000  | 80   | 1.5                                | 400  | 1.5                             | 1,200  | 2.25                            | 0.15※                            |
| 4020-0300           | 2                     | 3                  | 10,000  | 80   | 2                                  | 400  | 2                               | 1,200  | 3                               | 0.2※                             |
| 4025-0375           | 2.5                   | 3.75               | 8,000   | 100  | 2.5                                | 650  | 2.5                             | 1,800  | 3.75                            | 0.25※                            |
| 4030-0450           | 3                     | 4.5                | 6,800   | 100  | 3                                  | 650  | 3                               | 1,800  | 4.5                             | 0.3※                             |
| 4040-0600           | 4                     | 6                  | 5,700   | 110  | 4                                  | 650  | 4                               | 1,000  | 6                               | 0.8                              |
| 4050-0750           | 5                     | 7.5                | 4,800   | 110  | 5                                  | 700  | 5                               | 1,100  | 7.5                             | 1                                |
| 4060-0900           | 6                     | 9                  | 4,000   | 120  | 6                                  | 700  | 6                               | 1,200  | 9                               | 1.2                              |
| 4070-1050           | 7                     | 10.5               | 3,400   | 110  | 6※1                                | 700  | 7                               | 1,150  | 10.5                            | 1.4                              |
| 4080-1200           | 8                     | 12                 | 2,700   | 110  | 6※1                                | 700  | 8                               | 1,050  | 12                              | 1.6                              |
| 4090-1350           | 9                     | 13.5               | 2,300   | 100  | 6※1                                | 700  | 9                               | 1,000  | 13.5                            | 1.8                              |
| 4100-1500           | 10                    | 15                 | 1,900   | 100  | 6※1                                | 650  | 10                              | 900  | 15                              | 2                                |
| 4110-1650           | 11                    | 16.5               | 1,700   | 90   | 6※1                                | 650  | 11                              | 850  | 16.5                            | 2.2                              |
| 4120-1800           | 12                    | 18                 | 1,550   | 80   | 6※1                                | 600  | 12                              | 800  | 18                              | 2.4                              |
| 4160-2400           | 16                    | 24                 | 1,100   | 150  | Step Amount: 1.6<br>Max 10 depth※2 | 400  | 8※                              | 440  | 24                              | 3.2                              |
| 4200-3000           | 20                    | 30                 | 880   | 150  | Step Amount: 2<br>Max 10 depth※2   | 400  | 10※                             | 440  | 30                              | 4                                |
| Milling Amount (mm) |                       |                    |   | ※1 Depth: 1D<br>Max 6 mm<br>※2 0.1D depth<br>(Max 10 mm) |                                    | ※ a <sub>p</sub> : 1D<br>a <sub>p</sub> : 0.5D |                                 | a <sub>p</sub> : Length of Cut<br>a <sub>e</sub> : 0.2D<br>※ a <sub>e</sub> : 0.1D |                                 |                                  |

# Milling Conditions for CZS

4 Flutes

| WORK MATERIAL       |                       |                    | STRUCTURAL STEELS<br>SS400         |  |                                    |  |                        |   |                        |                   |  |
|---------------------|-----------------------|--------------------|------------------------------------|--|------------------------------------|--|------------------------|---|------------------------|-------------------|--|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> ) | Recommend water soluble or oil coolant. (Use cutting oils for vertical milling.) |                                    |  |                        |   |                        |                   |  |
|                     |                       |                    |                                    | Vertical   |                                    | Slotting   |                        | Side Milling  |                        | Radial Depth (mm) |  |
|                     |                       |                    |                                    | Feed Rate (mm/min)   | $a_p$ Axial Depth (mm)             | Feed Rate (mm/min)                                   | $a_p$ Axial Depth (mm) | Feed Rate (mm/min)  | $a_p$ Axial Depth (mm) |                   |  |
| 4010-0150           | 1                     | 1.5                | 18,000                             | 100  | 0.25※1                             | 400  | 0.25※1                 | 1,200   | 1.5                    | 0.1※              |  |
| 4015-0225           | 1.5                   | 2.25               | 16,000                             | 100  | 0.375※1                            | 600  | 0.375※1                | 1,800   | 2.25                   | 0.15※             |  |
| 4020-0300           | 2                     | 3                  | 12,000                             | 200  | 0.5※1                              | 600  | 0.5※1                  | 1,800   | 3                      | 0.2※              |  |
| 4025-0375           | 2.5                   | 3.75               | 10,000                             | 300  | 1.25                               | 950  | 2.5                    | 2,400   | 3.75                   | 0.25※             |  |
| 4030-0450           | 3                     | 4.5                | 8,500                              | 300  | 1.5                                | 950  | 3                      | 2,400   | 4.5                    | 0.3※              |  |
| 4040-0600           | 4                     | 6                  | 7,200                              | 300  | 2                                  | 950  | 4                      | 1,350   | 6                      | 0.8               |  |
| 4050-0750           | 5                     | 7.5                | 6,000                              | 300  | 2.5                                | 1,000  | 5                      | 1,500   | 7.5                    | 1                 |  |
| 4060-0900           | 6                     | 9                  | 5,000                              | 300  | 3                                  | 1,000  | 6                      | 1,600   | 9                      | 1.2               |  |
| 4070-1050           | 7                     | 10.5               | 4,200                              | 300  | 3.5                                | 900  | 7                      | 1,500   | 10.5                   | 1.4               |  |
| 4080-1200           | 8                     | 12                 | 3,500                              | 250  | 4                                  | 850  | 8                      | 1,400   | 12                     | 1.6               |  |
| 4090-1350           | 9                     | 13.5               | 2,900                              | 250  | 4.5                                | 800  | 9                      | 1,300   | 13.5                   | 1.8               |  |
| 4100-1500           | 10                    | 15                 | 2,300                              | 200  | 5                                  | 750  | 10                     | 1,200   | 15                     | 2                 |  |
| 4110-1650           | 11                    | 16.5               | 2,050                              | 200  | 5.5                                | 750  | 11                     | 1,150   | 16.5                   | 2.2               |  |
| 4120-1800           | 12                    | 18                 | 1,850                              | 180  | 6                                  | 700  | 12                     | 1,100   | 18                     | 2.4               |  |
| 4160-2400           | 16                    | 24                 | 1,380                              | 150  | Step Amount: 1.6<br>Max 10 depth※2 | 830  | 8※2                    | 550   | 24                     | 3.2               |  |
| 4200-3000           | 20                    | 30                 | 1,000                              | 150  | Step Amount: 2<br>Max 10 depth※2   | 830  | 10※2                   | 500   | 30                     | 4                 |  |
| Milling Amount (mm) |                       |                    |                                    | ※1 Depth: 0.5D<br>Depth: 0.25D<br>※2 Depth: 0.1D<br>(Max 10 mm)                  |                                    | ※1 $a_p$ : 1D<br>※1 $a_p$ : 0.25D<br>※2 $a_p$ : 0.5D |                        | ※ $a_p$ : Length of Cut<br>$a_e$ : 0.2D<br>※ $a_e$ : 0.1D |                        |                   |  |

| WORK MATERIAL       |                       |                    | STAINLESS STEELS<br>SUS304         |                                    |                        |                                |                        |  |                        |                   |  |
|---------------------|-----------------------|--------------------|------------------------------------|------------------------------------|------------------------|--------------------------------|------------------------|--|------------------------|-------------------|--|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> ) | Use water soluble or oil coolant.  |                        |                                |                        |  |                        |                   |  |
|                     |                       |                    |                                    | Vertical                           |                        | Slotting                       |                        | Side Milling   |                        | Radial Depth (mm) |  |
|                     |                       |                    |                                    | Feed Rate (mm/min)                 | $a_p$ Axial Depth (mm) | Feed Rate (mm/min)             | $a_p$ Axial Depth (mm) | Feed Rate (mm/min)   | $a_p$ Axial Depth (mm) |                   |  |
| 4010-0150           | 1                     | 1.5                | 14,500                             | 150                                | 0.25                   | 250                            | 1                      | 1,000  | 1.5                    | 0.05※             |  |
| 4015-0225           | 1.5                   | 2.25               | 13,000                             | 150                                | 0.375                  | 270                            | 1.5                    | 1,500  | 2.25                   | 0.075※            |  |
| 4020-0300           | 2                     | 3                  | 10,000                             | 100                                | 0.5                    | 270                            | 2                      | 1,500  | 3                      | 0.1※              |  |
| 4025-0375           | 2.5                   | 3.75               | 8,000                              | 100                                | 0.625                  | 300                            | 2.5                    | 2,000  | 3.75                   | 0.125※            |  |
| 4030-0450           | 3                     | 4.5                | 6,800                              | 80                                 | 0.75                   | 300                            | 3                      | 2,000  | 4.5                    | 0.15※             |  |
| 4040-0600           | 4                     | 6                  | 5,700                              | 90                                 | 1                      | 350                            | 4                      | 1,150  | 6                      | 0.4               |  |
| 4050-0750           | 5                     | 7.5                | 4,800                              | 100                                | 1.25                   | 400                            | 5                      | 1,300  | 7.5                    | 0.5               |  |
| 4060-0900           | 6                     | 9                  | 4,000                              | 100                                | 1.5                    | 400                            | 6                      | 1,300  | 9                      | 0.6               |  |
| 4070-1050           | 7                     | 10.5               | 3,200                              | 100                                | 1.75                   | 350                            | 7                      | 1,300  | 10.5                   | 0.7               |  |
| 4080-1200           | 8                     | 12                 | 2,400                              | 90                                 | 2※                     | 300                            | 8                      | 1,200  | 12                     | 0.8               |  |
| 4090-1350           | 9                     | 13.5               | 1,800                              | 90                                 | 2※                     | 250                            | 9                      | 1,100  | 13.5                   | 0.9               |  |
| 4100-1500           | 10                    | 15                 | 1,400                              | 80                                 | 2※                     | 200                            | 10                     | 1,000  | 15                     | 1                 |  |
| 4110-1650           | 11                    | 16.5               | 1,250                              | 80                                 | 2※                     | 200                            | 11                     | 900  | 16.5                   | 1.1               |  |
| 4120-1800           | 12                    | 18                 | 1,250                              | 70                                 | 2※                     | 180                            | 12                     | 900  | 18                     | 1.2               |  |
| 4160-2400           | 16                    | 24                 | 1,250                              | 70                                 | 2※                     | 450                            | 6.4※                   | 440  | 24                     | 1.6               |  |
| 4200-3000           | 20                    | 30                 | 1,000                              | 70                                 | 2※                     | 450                            | 8※                     | 440  | 30                     | 2                 |  |
| Milling Amount (mm) |                       |                    |                                    | ※ Depth: 0.25D<br>※ Max 2 mm depth |                        | ※ $a_p$ : 1D<br>※ $a_p$ : 0.4D |                        | ※ $a_p$ : Length of Cut<br>$a_e$ : 0.1D<br>※ $a_e$ : 0.05D |                        |                   |  |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square Long Neck Square
- Radius Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Milling Conditions for CZS

| WORK MATERIAL       |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                                 |                                 |  |                                 |   |                                 |                                  |
|---------------------|-----------------------|--------------------|---|---------------------------------|---------------------------------|--|---------------------------------|---|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Vertical                        |                                 | Slotting   |                                 | Side Milling  |                                 |                                  |
|                     |                       |                    |   | Feed Rate (mm/min)              | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)   | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)  | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-0150           | 1                     | 1.5                | 14,500  | 100                             | 0.5                             | 120  | 1                               | 600   | 1.5                             | 0.05※                            |
| 4015-0225           | 1.5                   | 2.25               | 12,000  | 150                             | 0.75                            | 320  | 1.5                             | 900   | 2.25                            | 0.075※                           |
| 4020-0300           | 2                     | 3                  | 9,000   | 150                             | 1                               | 320  | 2                               | 900   | 3                               | 0.1※                             |
| 4025-0375           | 2.5                   | 3.75               | 7,500   | 200                             | 1.25                            | 520  | 2.5                             | 1,200   | 3.75                            | 0.125※                           |
| 4030-0450           | 3                     | 4.5                | 6,800   | 200                             | 1.5                             | 520  | 3                               | 1,200   | 4.5                             | 0.15※                            |
| 4040-0600           | 4                     | 6                  | 5,100   | 220                             | 2                               | 520  | 4                               | 700   | 6                               | 0.4                              |
| 4050-0750           | 5                     | 7.5                | 4,050   | 240                             | 2.5                             | 520  | 5                               | 850   | 7.5                             | 0.5                              |
| 4060-0900           | 6                     | 9                  | 3,300   | 240                             | 3                               | 520  | 6                               | 1,000   | 9                               | 0.6                              |
| 4070-1050           | 7                     | 10.5               | 2,900   | 240                             | 3※                              | 500  | 6※1                             | 1,000   | 10.5                            | 0.7                              |
| 4080-1200           | 8                     | 12                 | 2,300   | 220                             | 3※                              | 470  | 6※1                             | 900   | 12                              | 0.8                              |
| 4090-1350           | 9                     | 13.5               | 1,900   | 220                             | 3※                              | 470  | 6※1                             | 900   | 13.5                            | 0.9                              |
| 4100-1500           | 10                    | 15                 | 1,500   | 200                             | 3※                              | 450  | 6※1                             | 900   | 15                              | 1                                |
| 4110-1650           | 11                    | 16.5               | 1,350   | 200                             | 3※                              | 450  | 6※1                             | 850   | 16.5                            | 1.1                              |
| 4120-1800           | 12                    | 18                 | 1,200   | 180                             | 3※                              | 420  | 6※1                             | 800   | 18                              | 1.2                              |
| 4160-2400           | 16                    | 24                 | 1,110   | 150                             | 3※                              | 400  | 4~8※2                           | 440   | 24                              | 0.8※                             |
| 4200-3000           | 20                    | 30                 | 880   | 150                             | 3※                              | 400  | 5~10※2                          | 440   | 30                              | 1※                               |
| Milling Amount (mm) |                       |                    |   | ※ Depth: 0.5D<br>Max 3 mm depth |                                 | a <sub>p</sub> : 1D<br>※1 a <sub>p</sub> : Max 6 mm<br>※2 a <sub>p</sub> : 0.25~0.5D |                                 | a <sub>p</sub> : Length of Cut<br>a <sub>e</sub> : 0.1D<br>※ a <sub>e</sub> : 0.05D |                                 |                                  |

| WORK MATERIAL       |                       |                    | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                              |                                 |  |                                 |   |                                 |                                  |
|---------------------|-----------------------|--------------------|---|------------------------------|---------------------------------|--|---------------------------------|---|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                  | Vertical                     |                                 | Slotting   |                                 | Side Milling  |                                 |                                  |
|                     |                       |                    |   | Feed Rate (mm/min)           | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)   | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)  | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-0150           | 1                     | 1.5                | 12,900  | 80                           | 0.25                            | 50   | 0.25※1                          | 300   | 1.5                             | 0.05※                            |
| 4015-0225           | 1.5                   | 2.25               | 10,000  | 150                          | 0.375                           | 100  | 0.375※1                         | 650   | 2.25                            | 0.075※                           |
| 4020-0300           | 2                     | 3                  | 8,200   | 150                          | 0.5                             | 150  | 0.5※1                           | 650   | 3                               | 0.1※                             |
| 4025-0375           | 2.5                   | 3.75               | 7,000   | 250                          | 0.625                           | 300  | 2.5                             | 1,000   | 3.75                            | 0.125※                           |
| 4030-0450           | 3                     | 4.5                | 6,120   | 250                          | 0.75                            | 300  | 3                               | 1,000   | 4.5                             | 0.15※                            |
| 4040-0600           | 4                     | 6                  | 5,000   | 220                          | 1                               | 320  | 4                               | 600   | 6                               | 0.4                              |
| 4050-0750           | 5                     | 7.5                | 4,300   | 180                          | 1.25                            | 340  | 5                               | 800   | 7.5                             | 0.5                              |
| 4060-0900           | 6                     | 9                  | 3,600   | 160                          | 1.5                             | 360  | 6                               | 1,000   | 9                               | 0.6                              |
| 4070-1050           | 7                     | 10.5               | 2,800   | 160                          | 1.5※                            | 320  | 7                               | 1,000   | 10.5                            | 0.7                              |
| 4080-1200           | 8                     | 12                 | 2,100   | 150                          | 1.5※                            | 280  | 8                               | 1,000   | 12                              | 0.8                              |
| 4090-1350           | 9                     | 13.5               | 1,600   | 130                          | 1.5※                            | 240  | 9                               | 950   | 13.5                            | 0.9                              |
| 4100-1500           | 10                    | 15                 | 1,250   | 120                          | 1.5※                            | 200  | 10                              | 750   | 15                              | 1                                |
| 4110-1650           | 11                    | 16.5               | 1,150   | 110                          | 1.5※                            | 190  | 11                              | 720   | 16.5                            | 1.1                              |
| 4120-1800           | 12                    | 18                 | 1,050   | 110                          | 1.5※                            | 180  | 12                              | 700   | 18                              | 1.2                              |
| 4160-2400           | 16                    | 24                 | 800   | 50                           | 1.5※                            | 300  | 1.6※2                           | 320   | 24                              | 0.8※                             |
| 4200-3000           | 20                    | 30                 | 630   | 50                           | 1.5※                            | 300  | 2※2                             | 320   | 30                              | 1※                               |
| Milling Amount (mm) |                       |                    |   | ※ Depth: 0.25D<br>Max 1.5 mm |                                 | a <sub>p</sub> : 1D<br>※1 a <sub>p</sub> : 0.25D<br>※2 a <sub>p</sub> : 0.1D |                                 | a <sub>p</sub> : Length of Cut<br>a <sub>e</sub> : 0.1D<br>※ a <sub>e</sub> : 0.05D |                                 |                                  |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for CZS

### ◆ Standard flute length type

| WORK MATERIAL       |                       |                    | CARBON STEELS<br>S45C / S50C<br>Annealed Materials<br>(~225HB) |   |                                   |  |                                 |  |                                 |                                  |
|---------------------|-----------------------|--------------------|--|---|-----------------------------------|--|---------------------------------|--|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                             | Vertical                                  |                                   | Slotting                                       |                                 | Side Milling   |                                 |                                  |
|                     |                       |                    |  | Feed Rate (mm/min)                        | a <sub>p</sub> Axial Depth (mm)   | Feed Rate (mm/min)                             | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)   | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-0250           | 1                     | 2.5                | 18,000   | 100                                       | 1                                 | 200  | 0.5※                            | 1,200  | 1.5                             | 0.1※                             |
| 4020-0600           | 2                     | 6                  | 12,000   | 150                                       | 2                                 | 400  | 1※                              | 1,800  | 3                               | 0.2※                             |
| 4030-0800           | 3                     | 8                  | 8,500  | 250                                       | 3                                 | 600  | 3                               | 2,400  | 4.5                             | 0.3※                             |
| 4040-1100           | 4                     | 11                 | 7,200  | 270                                       | 4                                 | 650  | 4                               | 1,350  | 6                               | 0.8                              |
| 4050-1300           | 5                     | 13                 | 6,000  | 300                                       | 5                                 | 700  | 5                               | 1,500  | 7.5                             | 1                                |
| 4060-1300           | 6                     | 13                 | 5,000  | 300                                       | 6                                 | 700  | 6                               | 1,600  | 9                               | 1.2                              |
| 4070-1600           | 7                     | 16                 | 4,200  | 300                                       | 7                                 | 700  | 7                               | 1,500  | 10.5                            | 1.4                              |
| 4080-1900           | 8                     | 19                 | 3,500  | 300                                       | 8                                 | 700  | 8                               | 1,400  | 12                              | 1.6                              |
| 4090-1900           | 9                     | 19                 | 2,900  | 300                                       | 9                                 | 700  | 9                               | 1,300  | 13.5                            | 1.8                              |
| 4100-2200           | 10                    | 22                 | 2,300  | 300                                       | 10                                | 700  | 10                              | 1,200  | 15                              | 2                                |
| 4110-2200           | 11                    | 22                 | 2,050  | 280                                       | 11                                | 670  | 11                              | 1,150  | 16.5                            | 2.2                              |
| 4120-2600           | 12                    | 26                 | 1,850  | 260                                       | 12                                | 650  | 12                              | 1,100  | 18                              | 2.4                              |
| 4130-2600           | 13                    | 26                 | 1,400  | 80  | 13                                | 300  | 13                              | 700  | 19.5                            | 1.3※                             |
| 4160-3200           | 16                    | 32                 | 1,380  | 150                                       | Step Amount: 1.6<br>Max 10 depth※ | 830  | 8※                              | 550  | 24                              | 3.2                              |
| 4200-4000           | 20                    | 40                 | 1,000  | 150                                       | Step Amount: 2<br>Max 10 depth※   | 830  | 10※                             | 500  | 30                              | 4                                |
| Milling Amount (mm) |                       |                    |  | ※ Depth: 1D<br>Depth: 0.1D<br>(Max 10 mm) |                                   | ※ a <sub>p</sub> :1D<br>※ a <sub>p</sub> :0.5D |                                 | a <sub>p</sub> :1.5D<br>a <sub>e</sub> :0.2D<br>※ a <sub>e</sub> :0.1D |                                 |                                  |

| WORK MATERIAL       |                       |                    | ALLOY STEELS<br>SK / SCM<br>Annealed Materials<br>(225~325HB) |   |                                    |  |                                 |  |                                 |                                  |
|---------------------|-----------------------|--------------------|---|---|------------------------------------|--|---------------------------------|--|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                            | Vertical  |                                    | Slotting                                       |                                 | Side Milling   |                                 |                                  |
|                     |                       |                    |   | Feed Rate (mm/min)  | a <sub>p</sub> Axial Depth (mm)    | Feed Rate (mm/min)                             | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)   | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-0250           | 1                     | 2.5                | 14,500  | 50  | 1                                  | 150  | 0.5※                            | 900  | 1.5                             | 0.1※                             |
| 4020-0600           | 2                     | 6                  | 10,000  | 80  | 2                                  | 300  | 1※                              | 1,200  | 3                               | 0.2※                             |
| 4030-0800           | 3                     | 8                  | 6,800   | 100   | 3                                  | 400  | 3                               | 1,800  | 4.5                             | 0.3※                             |
| 4040-1100           | 4                     | 11                 | 5,700   | 110   | 4                                  | 450  | 4                               | 1,000  | 6                               | 0.8                              |
| 4050-1300           | 5                     | 13                 | 4,800   | 110   | 5                                  | 500  | 5                               | 1,100  | 7.5                             | 1                                |
| 4060-1300           | 6                     | 13                 | 4,000   | 120   | 6                                  | 500  | 6                               | 1,200  | 9                               | 1.2                              |
| 4070-1600           | 7                     | 16                 | 3,400   | 110   | 6※1                                | 500  | 7                               | 1,150  | 10.5                            | 1.4                              |
| 4080-1900           | 8                     | 19                 | 2,700   | 110   | 6※1                                | 500  | 8                               | 1,050  | 12                              | 1.6                              |
| 4090-1900           | 9                     | 19                 | 2,300   | 100   | 6※1                                | 500  | 9                               | 1,000  | 13.5                            | 1.8                              |
| 4100-2200           | 10                    | 22                 | 1,900   | 100   | 6※1                                | 500  | 10                              | 900  | 15                              | 2                                |
| 4110-2200           | 11                    | 22                 | 1,700   | 90  | 6※1                                | 450  | 11                              | 850  | 16.5                            | 2.2                              |
| 4120-2600           | 12                    | 26                 | 1,550   | 80  | 6※1                                | 450  | 12                              | 800  | 18                              | 2.4                              |
| 4130-2600           | 13                    | 26                 | 1,100   | 25  | 6※1                                | 180  | 13                              | 550  | 19.5                            | 1.3※                             |
| 4160-3200           | 16                    | 32                 | 1,100   | 150   | Step Amount: 1.6<br>Max 10 depth※2 | 300  | 8※                              | 440  | 24                              | 3.2                              |
| 4200-4000           | 20                    | 40                 | 880   | 150   | Step Amount: 2<br>Max 10 depth※2   | 300  | 10※                             | 440  | 30                              | 4                                |
| Milling Amount (mm) |                       |                    |   | ※1 Depth: 1D<br>Max 6 mm<br>※2 Depth: 0.1D<br>(Max 10 mm) |                                    | ※ a <sub>p</sub> :1D<br>※ a <sub>p</sub> :0.5D |                                 | a <sub>p</sub> :1.5D<br>a <sub>e</sub> :0.2D<br>※ a <sub>e</sub> :0.1D |                                 |                                  |

4 Flutes

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for CZS

| WORK MATERIAL       |                       |                    | STRUCTURAL STEELS<br>SS400<br>Recommend water soluble or oil coolant. (Use cutting oils for vertical milling.) |  |  |   |                                 |                    |                                 |                                  |
|---------------------|-----------------------|--------------------|--|--|--|---|---------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )   | Vertical   |  | Slotting  |                                 | Side Milling       |                                 |                                  |
|                     |                       |                    |  | Feed Rate (mm/min)                               | a <sub>p</sub> Axial Depth (mm)                    | Feed Rate (mm/min)  | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-0250           | 1                     | 2.5                | 18,000   | 100  | 0.25※1   | 400   | 0.25※1                          | 1,200              | 1.5                             | 0.1※                             |
| 4020-0600           | 2                     | 6                  | 12,000   | 200  | 0.5※1  | 600   | 0.5※1                           | 1,800              | 3                               | 0.2※                             |
| 4030-0800           | 3                     | 8                  | 8,500  | 300  | 1.5  | 600   | 3                               | 2,400              | 4.5                             | 0.3※                             |
| 4040-1100           | 4                     | 11                 | 7,200  | 300  | 2  | 650   | 4                               | 1,350              | 6                               | 0.8                              |
| 4050-1300           | 5                     | 13                 | 6,000  | 300  | 2.5  | 700   | 5                               | 1,500              | 7.5                             | 1                                |
| 4060-1300           | 6                     | 13                 | 5,000  | 300  | 3  | 700   | 6                               | 1,600              | 9                               | 1.2                              |
| 4070-1600           | 7                     | 16                 | 4,200  | 270  | 3.5  | 700   | 7                               | 1,500              | 10.5                            | 1.4                              |
| 4080-1900           | 8                     | 19                 | 3,500  | 250  | 4  | 700   | 8                               | 1,400              | 12                              | 1.6                              |
| 4090-1900           | 9                     | 19                 | 2,900  | 220  | 4.5  | 700   | 9                               | 1,300              | 13.5                            | 1.8                              |
| 4100-2200           | 10                    | 22                 | 2,300  | 200  | 5  | 700   | 10                              | 1,200              | 15                              | 2                                |
| 4110-2200           | 11                    | 22                 | 2,050  | 190  | 5.5  | 680   | 11                              | 1,150              | 16.5                            | 2.2                              |
| 4120-2600           | 12                    | 26                 | 1,850  | 180  | 6  | 650   | 12                              | 1,100              | 18                              | 2.4                              |
| 4130-2600           | 13                    | 26                 | 1,100  | 55   | 6.5  | 180   | 13                              | 550                | 19.5                            | 1.3※                             |
| 4160-3200           | 16                    | 32                 | 1,380  | 150  | Step Amount: 1.6<br>Max 10 depth※2                 | 830   | 8※2                             | 550                | 24                              | 3.2                              |
| 4200-4000           | 20                    | 40                 | 1,000  | 150  | Step Amount: 2<br>Max 10 depth※2                   | 830   | 10※2                            | 500                | 30                              | 4                                |
| Milling Amount (mm) |                       |                    |  | ※1 Depth: 0.5D<br>※2 Depth: 0.25D<br>(Max 10 mm) | ※1 a <sub>p</sub> : 1D<br>※2 a <sub>p</sub> : 0.5D | ※ a <sub>p</sub> : 1.5D<br>※ a <sub>e</sub> : 0.2D<br>※ a <sub>e</sub> : 0.1D |                                 |                    |                                 |                                  |

| WORK MATERIAL       |                       |                    | STAINLESS STEELS<br>SUS304<br>Use water soluble or oil coolant. |  |  |  |                                 |                    |                                 |                                  |
|---------------------|-----------------------|--------------------|---|--|--|--|---------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                              | Vertical   |  | Slotting   |                                 | Side Milling       |                                 |                                  |
|                     |                       |                    |   | Feed Rate (mm/min)                                       | a <sub>p</sub> Axial Depth (mm)                    | Feed Rate (mm/min)   | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-0250           | 1                     | 2.5                | 14,500  | 150  | 0.25   | 250  | 0.5                             | 1,000              | 1.5                             | 0.05※                            |
| 4020-0600           | 2                     | 6                  | 10,000  | 100  | 0.5  | 270  | 1                               | 1,500              | 3                               | 0.1※                             |
| 4030-0800           | 3                     | 8                  | 6,800   | 80   | 0.75   | 300  | 1.5                             | 2,000              | 4.5                             | 0.15※                            |
| 4040-1100           | 4                     | 11                 | 5,700   | 90   | 1  | 350  | 2                               | 1,150              | 6                               | 0.4                              |
| 4050-1300           | 5                     | 13                 | 4,800   | 100  | 1.25   | 400  | 2.5                             | 1,300              | 7.5                             | 0.5                              |
| 4060-1300           | 6                     | 13                 | 4,000   | 100  | 1.5  | 400  | 3                               | 1,300              | 9                               | 0.6                              |
| 4070-1600           | 7                     | 16                 | 3,200   | 100  | 1.75   | 350  | 3.5                             | 1,300              | 10.5                            | 0.7                              |
| 4080-1900           | 8                     | 19                 | 2,400   | 90   | 2※1  | 300  | 4                               | 1,200              | 12                              | 0.8                              |
| 4090-1900           | 9                     | 19                 | 1,800   | 90   | 2※1  | 250  | 4.5                             | 1,100              | 13.5                            | 0.9                              |
| 4100-2200           | 10                    | 22                 | 1,400   | 80   | 2※1  | 200  | 5                               | 1,000              | 15                              | 1                                |
| 4110-2200           | 11                    | 22                 | 1,250   | 80   | 2※1  | 200  | 5.5                             | 900                | 16.5                            | 1.1                              |
| 4120-2600           | 12                    | 26                 | 1,250   | 70   | 2※1  | 180  | 6                               | 900                | 18                              | 1.2                              |
| 4130-2600           | 13                    | 26                 | 1,050   | 20   | 1.5※2  | 120  | 6.5                             | 900                | 19.5                            | 0.65※                            |
| 4160-3200           | 16                    | 32                 | 1,250   | 70   | 2※1  | 450  | 1.6※                            | 440                | 24                              | 1.6                              |
| 4200-4000           | 20                    | 40                 | 1,000   | 70   | 2※1  | 450  | 2※                              | 440                | 30                              | 2                                |
| Milling Amount (mm) |                       |                    |   | ※1 Depth: 0.25D<br>※2 Max 2 mm depth<br>Max 1.5 mm depth | ※ a <sub>p</sub> : 0.5D<br>※ a <sub>p</sub> : 0.1D | ※ a <sub>p</sub> : 1.5D<br>※ a <sub>e</sub> : 0.1D<br>※ a <sub>e</sub> : 0.05D |                                 |                    |                                 |                                  |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

# Milling Conditions for CZS

4 Flutes

| WORK MATERIAL       |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                                  |                                 |   |                                 |   |                                 |                                  |
|---------------------|-----------------------|--------------------|---|----------------------------------|---------------------------------|---|---------------------------------|---|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Vertical                         |                                 | Slotting                                      |                                 | Side Milling  |                                 |                                  |
|                     |                       |                    |   | Feed Rate (mm/min)               | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)                            | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)  | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-0250           | 1                     | 2.5                | 12,900  | 80                               | 0.5                             | 140   | 1                               | 270   | 1.5                             | 0.2                              |
| 4020-0600           | 2                     | 6                  | 9,350   | 110                              | 1                               | 230   | 2                               | 400   | 3                               | 0.4                              |
| 4030-0800           | 3                     | 8                  | 6,120   | 120                              | 1.5                             | 270   | 3                               | 450   | 4.5                             | 0.6                              |
| 4040-1100           | 4                     | 11                 | 5,250   | 130                              | 2                               | 320   | 4                               | 500   | 6                               | 0.8                              |
| 4050-1300           | 5                     | 13                 | 4,460   | 150                              | 2.5                             | 360   | 5                               | 540   | 7.5                             | 1                                |
| 4060-1300           | 6                     | 13                 | 3,600   | 160                              | 3                               | 360   | 6                               | 540   | 9                               | 1.2                              |
| 4070-1600           | 7                     | 16                 | 2,850   | 140                              | 2**                             | 340   | 7                               | 540   | 10.5                            | 1.4                              |
| 4080-1900           | 8                     | 19                 | 2,320   | 90                               | 2**                             | 320   | 8                               | 480   | 12                              | 1.6                              |
| 4090-1900           | 9                     | 19                 | 1,700   | 80                               | 2**                             | 250   | 9                               | 410   | 13.5                            | 1.8                              |
| 4100-2200           | 10                    | 22                 | 1,250   | 60                               | 2**                             | 180   | 10                              | 340   | 15                              | 2                                |
| 4110-2200           | 11                    | 22                 | 1,100   | 55                               | 2**                             | 170   | 11                              | 320   | 16.5                            | 2.2                              |
| 4120-2600           | 12                    | 26                 | 1,050   | 50                               | 2**                             | 160   | 12                              | 320   | 18                              | 2.4                              |
| 4130-2600           | 13                    | 26                 | 1,000   | N/A                              | N/A                             | 100   | 6.5**                           | 300   | 19.5                            | 1.3**                            |
| 4160-3200           | 16                    | 32                 | 960   | 40                               | 2**                             | 350   | 8**                             | 380   | 24                              | 1.6**                            |
| 4200-4000           | 20                    | 40                 | 770   | 40                               | 2**                             | 350   | 10**                            | 380   | 30                              | 2**                              |
| Milling Amount (mm) |                       |                    |   | Depth: 0.5D<br>** Max 2 mm depth |                                 | a <sub>p</sub> :1D<br>** a <sub>p</sub> :0.5D |                                 | a <sub>p</sub> :1.5D<br>a <sub>e</sub> :0.2D<br>** a <sub>e</sub> :0.1D |                                 |                                  |

| WORK MATERIAL       |                       |                    | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |  |                                     |   |                                 |  |                                 |                                  |
|---------------------|-----------------------|--------------------|---|--|-------------------------------------|---|---------------------------------|--|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                  | Vertical   |                                     | Slotting  |                                 | Side Milling   |                                 |                                  |
|                     |                       |                    |   | Feed Rate (mm/min)   | a <sub>p</sub> Axial Depth (mm)     | Feed Rate (mm/min)  | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)   | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-0250           | 1                     | 2.5                | 12,900  | 80   | 0.25                                | 50  | 0.25**1                         | 300  | 1.5                             | 0.05**                           |
| 4020-0600           | 2                     | 6                  | 8,200   | 150  | 0.5                                 | 150   | 0.5**1                          | 650  | 3                               | 0.1**                            |
| 4030-0800           | 3                     | 8                  | 6,120   | 250  | 0.75                                | 300   | 1.5                             | 1,000  | 4.5                             | 0.15**                           |
| 4040-1100           | 4                     | 11                 | 5,000   | 220  | 1                                   | 320   | 2                               | 500  | 6                               | 0.4                              |
| 4050-1300           | 5                     | 13                 | 4,300   | 180  | 1.25                                | 340   | 2.5                             | 520  | 7.5                             | 0.5                              |
| 4060-1300           | 6                     | 13                 | 3,600   | 160  | 1.5                                 | 360   | 3                               | 540  | 9                               | 0.6                              |
| 4070-1600           | 7                     | 16                 | 2,800   | 160  | 1.5**1                              | 320   | 3.5                             | 520  | 10.5                            | 0.7                              |
| 4080-1900           | 8                     | 19                 | 2,100   | 150  | 1.5**1                              | 280   | 4                               | 500  | 12                              | 0.8                              |
| 4090-1900           | 9                     | 19                 | 1,600   | 130  | 1.5**1                              | 240   | 4.5                             | 470  | 13.5                            | 0.9                              |
| 4100-2200           | 10                    | 22                 | 1,250   | 120  | 1.5**1                              | 200   | 5                               | 450  | 15                              | 1                                |
| 4110-2200           | 11                    | 22                 | 1,150   | 110  | 1.5**1                              | 190   | 5.5                             | 440  | 16.5                            | 1.1                              |
| 4120-2600           | 12                    | 26                 | 1,050   | 110  | 1.5**1                              | 180   | 6                               | 420  | 18                              | 1.2                              |
| 4130-2600           | 13                    | 26                 | 900   | N/A  | N/A                                 | N/A   | N/A                             | 370  | 19.5                            | 0.65**                           |
| 4160-3200           | 16                    | 32                 | 800   | 50   | Step Amount: 1.6<br>Max 10 depth**2 | 300   | 1.6**2                          | 320  | 24                              | 0.8**                            |
| 4200-4000           | 20                    | 40                 | 630   | 50   | Step Amount: 2<br>Max 10 depth**2   | 300   | 2**2                            | 320  | 30                              | 1**                              |
| Milling Amount (mm) |                       |                    |   | Depth: 0.25D<br>**1 Max 1.5 mm<br>**2 Depth: 0.1D<br>(Max 10 mm) |                                     | a <sub>p</sub> :0.5D<br>**1 a <sub>p</sub> :0.25D<br>**2 a <sub>p</sub> :0.1D |                                 | a <sub>p</sub> :1.5D<br>a <sub>e</sub> :0.1D<br>** a <sub>e</sub> :0.05D |                                 |                                  |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Long Neck Square
- Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball
  - Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for CZS

### ◆3D flute length type

| WORK MATERIAL       |                       |                    | CARBON STEELS<br>S45C / S50C<br>Annealed Materials<br>(~225HB) |                    |                        |                    |                        |                                       |                        |                         |
|---------------------|-----------------------|--------------------|--|--------------------|------------------------|--------------------|------------------------|---------------------------------------|------------------------|-------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                             | Vertical           |                        | Slotting           |                        | Side Milling                          |                        |                         |
|                     |                       |                    |  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | Feed Rate (mm/min)                    | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 4060-1800           | 6                     | 18                 | 5,000  | 200                | 6                      | 500                | 6                      | 1,600                                 | 18                     | 0.6                     |
| 4070-2100           | 7                     | 21                 | 4,100  | 200                | 7                      | 450                | 7                      | 1,450                                 | 21                     | 0.7                     |
| 4080-2400           | 8                     | 24                 | 3,200  | 150                | 8                      | 400                | 8                      | 1,300                                 | 24                     | 0.8                     |
| 4090-2700           | 9                     | 27                 | 2,400  | 140                | 9                      | 350                | 9                      | 1,150                                 | 27                     | 0.9                     |
| 4100-3000           | 10                    | 30                 | 1,850  | 120                | 10                     | 320                | 10                     | 1,000                                 | 30                     | 1                       |
| 4110-3300           | 11                    | 33                 | 1,650  | 100                | 11                     | 300                | 11                     | 900                                   | 33                     | 1.1                     |
| 4120-3600           | 12                    | 36                 | 1,500  | 90                 | 12                     | 300                | 12                     | 800                                   | 36                     | 1.2                     |
| Milling Amount (mm) |                       |                    |  | Depth: 1D          |                        | $a_p$ : 1D         |                        | $a_p$ : Length of Cut<br>$a_e$ : 0.1D |                        |                         |

| WORK MATERIAL       |                       |                    | ALLOY STEELS<br>SK / SCM<br>Annealed Materials<br>(225~325HB) |                    |                        |                    |                        |                                       |                        |                         |
|---------------------|-----------------------|--------------------|---|--------------------|------------------------|--------------------|------------------------|---------------------------------------|------------------------|-------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                            | Vertical           |                        | Slotting           |                        | Side Milling                          |                        |                         |
|                     |                       |                    |   | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | Feed Rate (mm/min)                    | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 4060-1800           | 6                     | 18                 | 4,000   | 60                 | 6                      | 350                | 6                      | 1,200                                 | 18                     | 0.6                     |
| 4070-2100           | 7                     | 21                 | 3,400   | 60                 | 6                      | 330                | 7                      | 1,150                                 | 21                     | 0.7                     |
| 4080-2400           | 8                     | 24                 | 2,700   | 50                 | 6                      | 300                | 8                      | 1,050                                 | 24                     | 0.8                     |
| 4090-2700           | 9                     | 27                 | 2,050   | 50                 | 6                      | 270                | 9                      | 1,000                                 | 27                     | 0.9                     |
| 4100-3000           | 10                    | 30                 | 1,500   | 40                 | 6                      | 240                | 10                     | 900                                   | 30                     | 1                       |
| 4110-3300           | 11                    | 33                 | 1,350   | 40                 | 6                      | 220                | 11                     | 850                                   | 33                     | 1.1                     |
| 4120-3600           | 12                    | 36                 | 1,200   | 30                 | 6                      | 200                | 12                     | 750                                   | 36                     | 1.2                     |
| Milling Amount (mm) |                       |                    |   | Max 6 mm depth     |                        | $a_p$ : 1D         |                        | $a_p$ : Length of Cut<br>$a_e$ : 0.1D |                        |                         |

| WORK MATERIAL       |                       |                    | STRUCTURAL STEELS<br>SS400<br>Recommend water soluble or oil coolant. (Use cutting oils for vertical milling.) |                    |                        |                    |                        |                                       |                        |                         |
|---------------------|-----------------------|--------------------|--|--------------------|------------------------|--------------------|------------------------|---------------------------------------|------------------------|-------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )   | Vertical           |                        | Slotting           |                        | Side Milling                          |                        |                         |
|                     |                       |                    |  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | Feed Rate (mm/min)                    | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 4060-1800           | 6                     | 18                 | 4,000  | 120                | 3                      | 300                | 6                      | 1,300                                 | 18                     | 0.6                     |
| 4070-2100           | 7                     | 21                 | 3,400  | 110                | 3.5                    | 280                | 7                      | 1,200                                 | 21                     | 0.7                     |
| 4080-2400           | 8                     | 24                 | 2,700  | 90                 | 4                      | 250                | 8                      | 1,150                                 | 24                     | 0.8                     |
| 4090-2700           | 9                     | 27                 | 2,100  | 80                 | 4.5                    | 230                | 9                      | 1,050                                 | 27                     | 0.9                     |
| 4100-3000           | 10                    | 30                 | 1,500  | 70                 | 5                      | 200                | 10                     | 1,000                                 | 30                     | 1                       |
| 4110-3300           | 11                    | 33                 | 1,350  | 65                 | 5.5                    | 190                | 11                     | 950                                   | 33                     | 1.1                     |
| 4120-3600           | 12                    | 36                 | 1,200  | 60                 | 6                      | 190                | 12                     | 900                                   | 36                     | 1.2                     |
| Milling Amount (mm) |                       |                    |  | Depth: 0.5D        |                        | $a_p$ : 1D         |                        | $a_p$ : Length of Cut<br>$a_e$ : 0.1D |                        |                         |



## Milling Conditions for CZS

4 Flutes

| WORK MATERIAL       |                       |                    | STAINLESS STEELS<br>SUS304<br>Use water soluble or oil coolant. |                    |                                 |                       |                                 |  |                                 |                                  |
|---------------------|-----------------------|--------------------|---|--------------------|---------------------------------|-----------------------|---------------------------------|--|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                              | Vertical           |                                 | Slotting              |                                 | Side Milling   |                                 |                                  |
|                     |                       |                    |   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)    | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)                                       | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4060-1800           | 6                     | 18                 | 2,800   | 40                 | 1.5                             | 200                   | 3                               | 900  | 18                              | 0.3                              |
| 4070-2100           | 7                     | 21                 | 2,450   | 40                 | 1.5                             | 190                   | 3.5                             | 950  | 21                              | 0.35                             |
| 4080-2400           | 8                     | 24                 | 2,100   | 40                 | 1.5                             | 180                   | 4                               | 950  | 24                              | 0.4                              |
| 4090-2700           | 9                     | 27                 | 1,700   | 30                 | 1.5                             | 170                   | 4.5                             | 1,000  | 27                              | 0.45                             |
| 4100-3000           | 10                    | 30                 | 1,400   | 30                 | 1.5                             | 150                   | 5                               | 1,000  | 30                              | 0.5                              |
| 4110-3300           | 11                    | 33                 | 1,250   | 30                 | 1.5                             | 140                   | 5.5                             | 1,000  | 33                              | 0.55                             |
| 4120-3600           | 12                    | 36                 | 1,150   | 25                 | 1.5                             | 130                   | 6                               | 950  | 36                              | 0.6                              |
| Milling Amount (mm) |                       |                    |   | Max 1.5 mm depth   |                                 | a <sub>p</sub> : 0.5D |                                 | a <sub>p</sub> : Length of Cut<br>a <sub>e</sub> : 0.05D |                                 |                                  |

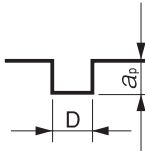
| WORK MATERIAL       |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                                 |                           |                                 |  |                                 |                                  |
|---------------------|-----------------------|--------------------|---|--------------------|---------------------------------|---------------------------|---------------------------------|--|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Vertical           |                                 | Slotting                  |                                 | Side Milling   |                                 |                                  |
|                     |                       |                    |   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)        | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)                                       | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4060-1800           | 6                     | 18                 | 3,000   | —                  | —                               | 160                       | 6                               | 600  | 18                              | 0.3                              |
| 4070-2100           | 7                     | 21                 | 2,500   | —                  | —                               | 160                       | 6                               | 700  | 21                              | 0.35                             |
| 4080-2400           | 8                     | 24                 | 2,150   | —                  | —                               | 150                       | 6                               | 750  | 24                              | 0.4                              |
| 4090-2700           | 9                     | 27                 | 1,850   | —                  | —                               | 150                       | 6                               | 800  | 27                              | 0.45                             |
| 4100-3000           | 10                    | 30                 | 1,500   | —                  | —                               | 140                       | 6                               | 900  | 30                              | 0.5                              |
| 4110-3300           | 11                    | 33                 | 1,350   | —                  | —                               | 130                       | 6                               | 850  | 33                              | 0.55                             |
| 4120-3600           | 12                    | 36                 | 1,200   | —                  | —                               | 120                       | 6                               | 800  | 36                              | 0.6                              |
| Milling Amount (mm) |                       |                    |   | N/A                |                                 | a <sub>p</sub> : Max 6 mm |                                 | a <sub>p</sub> : Length of Cut<br>a <sub>e</sub> : 0.05D |                                 |                                  |

| WORK MATERIAL       |                       |                    | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                                 |                    |                                 |  |                                 |                                  |
|---------------------|-----------------------|--------------------|---|--------------------|---------------------------------|--------------------|---------------------------------|--|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                  | Vertical           |                                 | Slotting           |                                 | Side Milling   |                                 |                                  |
|                     |                       |                    |   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Feed Rate (mm/min)                                       | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4060-1800           | 6                     | 18                 | 3,600   | —                  | —                               | —                  | —                               | 540  | 18                              | 0.3                              |
| 4070-2100           | 7                     | 21                 | 2,900   | —                  | —                               | —                  | —                               | 520  | 21                              | 0.35                             |
| 4080-2400           | 8                     | 24                 | 2,300   | —                  | —                               | —                  | —                               | 500  | 24                              | 0.4                              |
| 4090-2700           | 9                     | 27                 | 1,700   | —                  | —                               | —                  | —                               | 470  | 27                              | 0.45                             |
| 4100-3000           | 10                    | 30                 | 1,250   | —                  | —                               | —                  | —                               | 450  | 30                              | 0.5                              |
| 4110-3300           | 11                    | 33                 | 1,100   | —                  | —                               | —                  | —                               | 420  | 33                              | 0.55                             |
| 4120-3600           | 12                    | 36                 | 1,000   | —                  | —                               | —                  | —                               | 400  | 36                              | 0.6                              |
| Milling Amount (mm) |                       |                    |   | N/A                |                                 | N/A                |                                 | a <sub>p</sub> : Length of Cut<br>a <sub>e</sub> : 0.05D |                                 |                                  |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

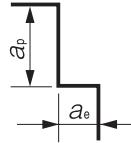
## Milling Conditions for CZS

Slotting



D : Outside Diameter (mm)

Side Milling



**Note:**

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machines maximum speed, or when the tool is chattering and heats up to a red color.
- These milling parameters are calculated based on the shortest overhang length. Longer overhangs may require an adjustment to the milling parameters.
- Reduce the milling amount and feed rate in accordance with required milling precision.
- Spindle rigidity should be considered when setting milling parameters, especially for Z-Axis drilling.
- When slotting, using Z-Axis drilling, the milling parameters should promote good chip evacuation.
- Reduce the milling amount when chips clog on the tool during Z-Axis drilling.
- The milling parameter of outside diameter 16 and 20 is calculated based on BT50 spindle type. Decrease 50% milling amount for BT40 spindle type.
- Recommend water soluble or oil coolant.
- Recommend water soluble coolant (through spindle type) for Stainless Steels and Aluminum Alloys.
- Recommend oil coolant for Titanium Alloys and Heat Resistant Alloys.

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Long Neck Square
- Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Pocket Milling Example  
CZS  $\phi 8 \times L12$

SCM420H

4 Flutes



Pocket Size : 9 × 15 × Depth 4 mm

Drilling and Milling → 144 min

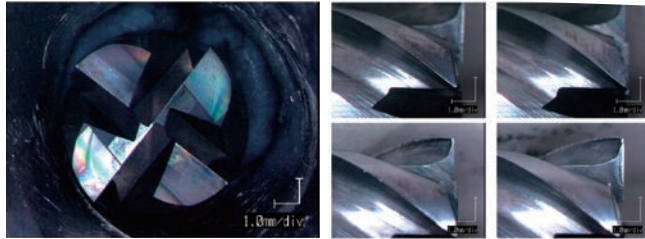
**CZS → 72 min**

**1/2  
Cycle Time!**

|                       |                         |
|-----------------------|-------------------------|
| Spindle Speed         | 2,700 min <sup>-1</sup> |
| Z-Drilling Feed Rate  | 220 mm/min              |
| X-Y Milling Feed Rate | 500 mm/min              |
| Number of holes       | 864 holes               |
| Coolant               | Water Soluble           |

Z-drilling Depth 1 mm × 4 times Dwell 0.1 sec

After milling 864 holes (32 pieces)

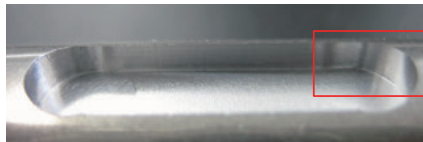
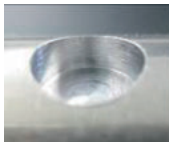


**Less cycle time! More tool life left after milling 864 holes!**

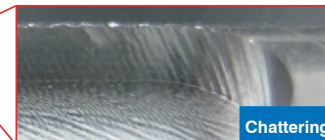
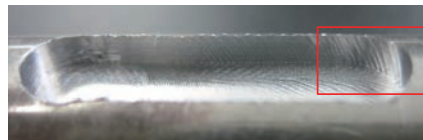
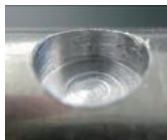
Comparison with Conventional Model  
CZS  $\phi 6.5 \times L16$

S45C

**CZS**



**Conventional 4 Flute Square**



|                      |  |
|----------------------|--|
| Spindle Speed        | 2,200 min <sup>-1</sup>                              |
| Z-Drilling Feed Rate | 100 mm/min   |
| Slotting Feed Rate   | 400 mm/min   |
| $a_p$                | 3 mm   |
| Overhang Length      | 25 mm  |
| Coolant              | Air Blow (Through Spindle)                           |
| Milled Size          | Slitting 6.5 × 24.5 × 3 mm<br>Spot Facing 6.5 × 3 mm |

**Variable Pitch Prevents Chattering!**

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 1 \sim \phi 16$

**CXES**



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

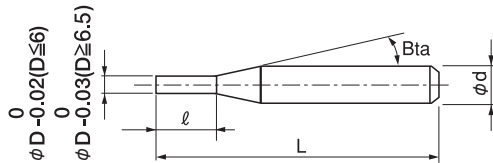
| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ○      |        |        |        | ○         |                 |          | ●      |          |                       | ○               | ○                     |                  |                                       |

**Features**

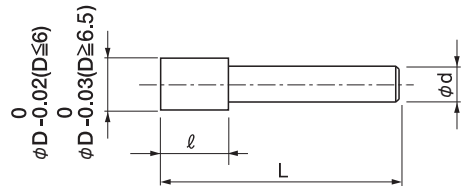
Variable Division & Helix design minimizes vibration and chattering.  
 Selected high toughness and chip resistant carbide material.  
 Optimized flute design offers outstandingly high efficiency milling and fine finishing.  
 Low friction coating resulting in excellent chip evacuation and resistance to wear.

The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece. Actual measurement is necessary when using longer length of cut than the written length.

Shape A



Shape B



Total 55 models

Unit (mm)

| Model Number   | Outside Diameter $\phi D$ | Length of Cut $l$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Shape | Suggested Retail Price ¥ |
|----------------|---------------------------|-------------------|-----------------------|------------------|-------------------------|-------|--------------------------|
| CXES 4010-0250 | 1                         | 2.5               | 16°                   | 50               | 4                       | A     | 6,520                    |
| CXES 4010-0300 |                           | 3                 |                       | 60               | 4                       |       | 7,180                    |
| CXES 4010-0400 |                           | 4                 |                       | 60               | 4                       |       | 7,900                    |
| CXES 4010-0500 |                           | 5                 |                       | 60               | 4                       |       | 10,270                   |
| CXES 4015-0375 | 1.5                       | 3.75              | 16°                   | 50               | 4                       | A     | 6,520                    |
| CXES 4015-0600 |                           | 6                 |                       | 50               | 4                       |       | 7,900                    |
| CXES 4020-0500 | 2                         | 5                 | 16°                   | 50               | 4                       | A     | 6,100                    |
| CXES 4020-0600 |                           | 6                 |                       | 60               | 4                       |       | 6,710                    |
| CXES 4020-0800 |                           | 8                 |                       | 60               | 4                       |       | 7,390                    |
| CXES 4020-1000 |                           | 10                |                       | 60               | 4                       |       | 9,610                    |
| CXES 4025-0625 |                           | 2.5               |                       | 6.25             | 16°                     |       | 50                       |
| CXES 4025-1000 | 10                        |                   | 50                    | 4                |                         | 7,390 |                          |

Unit (mm)

| Model Number   | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Shape | Suggested Retail Price ¥ |
|----------------|---------------------------|----------------------|-----------------------|------------------|-------------------------|-------|--------------------------|
| CXES 4030-0750 | 3                         | 7.5                  | 16°                   | 50               | 6                       | A     | 7,000                    |
| CXES 4030-0900 |                           | 9                    |                       | 60               | 6                       |       | 7,700                    |
| CXES 4030-1200 |                           | 12                   |                       | 60               | 6                       |       | 8,470                    |
| CXES 4030-1500 |                           | 15                   |                       | 60               | 6                       |       | 11,020                   |
| CXES 4035-0900 | 3.5                       | 9                    | 16°                   | 60               | 6                       | A     | 8,270                    |
| CXES 4040-1000 | 4                         | 10                   | 16°                   | 50               | 6                       | A     | 7,350                    |
| CXES 4040-1200 |                           | 12                   |                       | 60               | 6                       |       | 8,090                    |
| CXES 4040-1600 |                           | 16                   |                       | 60               | 6                       |       | 8,900                    |
| CXES 4040-2000 |                           | 20                   |                       | 60               | 6                       |       | 11,570                   |
| CXES 4045-1150 | 4.5                       | 11.5                 | 16°                   | 60               | 6                       | A     | 8,840                    |
| CXES 4050-1250 | 5                         | 12.5                 | 16°                   | 50               | 6                       | A     | 7,900                    |
| CXES 4050-1500 |                           | 15                   |                       | 60               | 6                       |       | 8,690                    |
| CXES 4050-2000 |                           | 20                   |                       | 60               | 6                       |       | 9,560                    |
| CXES 4050-2500 |                           | 25                   |                       | 70               | 6                       |       | 12,430                   |
| CXES 4055-1400 | 5.5                       | 14                   | 16°                   | 60               | 6                       | A     | 9,120                    |
| CXES 4060-1500 | 6                         | 15                   | —                     | 50               | 6                       | A     | 8,500                    |
| CXES 4060-1800 |                           | 18                   |                       | 60               | 6                       |       | 9,350                    |
| CXES 4060-2400 |                           | 24                   |                       | 70               | 6                       |       | 10,760                   |
| CXES 4060-3000 |                           | 30                   |                       | 80               | 6                       |       | 13,990                   |
| CXES 4065-1650 | 6.5                       | 16.5                 | 16°                   | 60               | 8                       | A     | 11,970                   |
| CXES 4070-1050 | 7                         | 10.5                 | —                     | 100              | 6                       | B     | 14,880                   |
| CXES 4070-1750 |                           | 17.5                 | 16°                   | 70               | 8                       | A     | 10,500                   |
| CXES 4075-1900 | 7.5                       | 19                   | 16°                   | 60               | 8                       | A     | 11,970                   |
| CXES 4080-2000 | 8                         | 20                   | —                     | 60               | 8                       | A     | 10,500                   |
| CXES 4080-2400 |                           | 24                   |                       | 70               | 8                       |       | 11,550                   |
| CXES 4080-3200 |                           | 32                   |                       | 80               | 8                       |       | 15,600                   |
| CXES 4080-4000 |                           | 40                   |                       | 90               | 8                       |       | 20,280                   |
| CXES 4085-2150 | 8.5                       | 21.5                 | 16°                   | 70               | 10                      | A     | 13,870                   |
| CXES 4090-1350 | 9                         | 13.5                 | —                     | 140              | 8                       | B     | 19,390                   |
| CXES 4090-2250 |                           | 22.5                 | 16°                   | 80               | 10                      | A     | 12,500                   |
| CXES 4095-2400 | 9.5                       | 24                   | 16°                   | 70               | 10                      | A     | 13,870                   |
| CXES 4100-2500 | 10                        | 25                   | —                     | 70               | 10                      | A     | 12,500                   |
| CXES 4100-3000 |                           | 30                   |                       | 80               | 10                      |       | 13,750                   |
| CXES 4100-4000 |                           | 40                   |                       | 90               | 10                      |       | 18,570                   |
| CXES 4100-5000 |                           | 50                   |                       | 100              | 10                      |       | 24,150                   |
| CXES 4110-1650 | 11                        | 16.5                 | —                     | 150              | 10                      | B     | 24,200                   |
| CXES 4110-2750 |                           | 27.5                 | 16°                   | 100              | 12                      | A     | 17,800                   |
| CXES 4120-3000 | 12                        | 30                   | —                     | 90               | 12                      | A     | 17,800                   |
| CXES 4120-3600 |                           | 36                   |                       | 100              | 12                      |       | 19,580                   |
| CXES 4120-4800 |                           | 48                   |                       | 110              | 12                      |       | 26,440                   |
| CXES 4120-6000 |                           | 60                   |                       | 120              | 12                      |       | 34,380                   |
| CXES 4130-1950 | 13                        | 19.5                 | —                     | 160              | 12                      | B     | 30,390                   |
| CXES 4160-4000 | 16                        | 40                   | —                     | 110              | 16                      | A     | 54,150                   |

4 Flutes

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for CXES

### Side Milling

| WORK MATERIAL                                    |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                                 |                                  | STAINLESS STEELS<br>SUS304<br>Use water soluble or oil coolant. |                    |                                 |                                  |
|--|-----------------------|--------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number                                     | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-0250<br>4010-0300<br>4010-0400<br>4010-0500 | 1                     | 2.5                | 18,000  | 620                | 2.5                             | 0.2                              | 18,000   | 460                | 2.5                             | 0.2                              | 14,500  | 320                | 2.5                             | 0.1                              |
|  |                       | 3                  | 18,000  | 620                | 3                               | 0.03                             | 18,000   | 460                | 3                               | 0.03                             | 14,300  | 310                | 3                               | 0.015                            |
|  |                       | 4                  | 18,000  | 620                | 4                               | 0.02                             | 18,000   | 460                | 4                               | 0.02                             | 13,900  | 290                | 4                               | 0.01                             |
|  |                       | 5                  | 18,000  | 620                | 5                               | 0.02                             | 18,000   | 460                | 5                               | 0.02                             | 13,900  | 290                | 5                               | 0.01                             |
| 4015-0375<br>4015-0600                           | 1.5                   | 3.75               | 13,500  | 770                | 3.75                            | 0.3                              | 13,500   | 570                | 3.75                            | 0.3                              | 13,300  | 340                | 3.75                            | 0.15                             |
|  |                       | 6                  | 13,500  | 770                | 6                               | 0.03                             | 13,500   | 570                | 6                               | 0.03                             | 12,700  | 310                | 6                               | 0.015                            |
| 4020-0500<br>4020-0600<br>4020-0800<br>4020-1000 | 2                     | 5                  | 11,000  | 930                | 5                               | 0.4                              | 11,000   | 690                | 5                               | 0.4                              | 12,200  | 360                | 5                               | 0.2                              |
|  |                       | 6                  | 11,000  | 930                | 6                               | 0.06                             | 11,000   | 690                | 6                               | 0.06                             | 12,000  | 340                | 6                               | 0.03                             |
|  |                       | 8                  | 11,000  | 930                | 8                               | 0.04                             | 11,000   | 690                | 8                               | 0.04                             | 11,600  | 300                | 8                               | 0.02                             |
|  |                       | 10                 | 11,000  | 930                | 10                              | 0.04                             | 11,000   | 690                | 10                              | 0.04                             | 11,600  | 300                | 10                              | 0.02                             |
| 4025-0625<br>4025-1000                           | 2.5                   | 6.25               | 9,500   | 1,060              | 6.25                            | 0.5                              | 9,500  | 800                | 6.25                            | 0.5                              | 11,000  | 490                | 6.25                            | 0.25                             |
|  |                       | 10                 | 9,500   | 1,060              | 10                              | 0.05                             | 9,500  | 800                | 10                              | 0.05                             | 10,400  | 430                | 10                              | 0.025                            |
| 4030-0750<br>4030-0900<br>4030-1200<br>4030-1500 | 3                     | 7.5                | 8,500   | 1,200              | 7.5                             | 0.6                              | 8,500  | 900                | 7.5                             | 0.6                              | 10,000  | 640                | 7.5                             | 0.3                              |
|  |                       | 9                  | 8,500   | 1,200              | 9                               | 0.3                              | 8,500  | 900                | 9                               | 0.3                              | 9,100   | 580                | 9                               | 0.15                             |
|  |                       | 12                 | 8,500   | 1,200              | 12                              | 0.06                             | 8,500  | 900                | 12                              | 0.06                             | 7,300   | 460                | 12                              | 0.03                             |
|  |                       | 15                 | 8,500   | 1,200              | 15                              | 0.06                             | 8,500  | 900                | 15                              | 0.06                             | 7,300   | 460                | 15                              | 0.03                             |
| 4035-0900  | 3.5                   | 9                  | 7,800   | 1,250              | 9                               | 0.7                              | 7,500  | 950                | 9                               | 0.7                              | 8,600   | 680                | 9                               | 0.35                             |
| 4040-1000<br>4040-1200<br>4040-1600<br>4040-2000 | 4                     | 10                 | 7,200   | 1,350              | 10                              | 0.8                              | 6,700  | 1,000              | 10                              | 0.8                              | 7,500   | 730                | 10                              | 0.4                              |
|  |                       | 12                 | 7,200   | 1,350              | 12                              | 0.4                              | 6,700  | 1,000              | 12                              | 0.4                              | 6,600   | 640                | 12                              | 0.2                              |
|  |                       | 16                 | 7,200   | 1,350              | 16                              | 0.08                             | 6,700  | 1,000              | 16                              | 0.08                             | 4,800   | 460                | 16                              | 0.08                             |
|  |                       | 20                 | 7,200   | 1,350              | 20                              | 0.08                             | 6,700  | 1,000              | 20                              | 0.08                             | 4,800   | 460                | 20                              | 0.08                             |
| 4045-1150  | 4.5                   | 11.5               | 6,550   | 1,400              | 11.5                            | 0.9                              | 6,000  | 1,050              | 11.5                            | 0.9                              | 6,300   | 770                | 11.5                            | 0.45                             |
| 4050-1250<br>4050-1500<br>4050-2000<br>4050-2500 | 5                     | 12.5               | 6,000   | 1,500              | 12.5                            | 1                                | 5,400  | 1,100              | 12.5                            | 1                                | 5,400   | 810                | 12.5                            | 0.5                              |
|  |                       | 15                 | 6,000   | 1,500              | 15                              | 0.5                              | 5,400  | 1,100              | 15                              | 0.5                              | 4,600   | 690                | 15                              | 0.25                             |
|  |                       | 20                 | 6,000   | 1,500              | 20                              | 0.1                              | 5,400  | 1,100              | 20                              | 0.1                              | 3,700   | 450                | 20                              | 0.1                              |
|  |                       | 25                 | 6,000   | 1,500              | 25                              | 0.1                              | 5,400  | 1,100              | 25                              | 0.1                              | 3,700   | 450                | 25                              | 0.1                              |
| 4055-1400  | 5.5                   | 14                 | 5,450   | 1,550              | 14                              | 1.1                              | 4,900  | 1,150              | 14                              | 1.1                              | 4,900   | 810                | 14                              | 0.55                             |
| 4060-1500<br>4060-1800<br>4060-2400<br>4060-3000 | 6                     | 15                 | 5,000   | 1,600              | 15                              | 1.2                              | 4,500  | 1,200              | 15                              | 1.2                              | 4,500   | 810                | 15                              | 0.6                              |
|  |                       | 18                 | 5,000   | 1,600              | 18                              | 0.6                              | 4,500  | 1,200              | 18                              | 0.6                              | 3,700   | 660                | 18                              | 0.3                              |
|  |                       | 24                 | 5,000   | 1,400              | 24                              | 0.12                             | 4,500  | 1,050              | 24                              | 0.12                             | 2,900   | 360                | 24                              | 0.12                             |
|  |                       | 30                 | 5,000   | 1,400              | 30                              | 0.12                             | 4,500  | 1,050              | 30                              | 0.12                             | 2,900   | 360                | 30                              | 0.12                             |
| 4065-1650  | 6.5                   | 16.5               | 4,400   | 1,500              | 16.5                            | 1.3                              | 3,950  | 1,150              | 16.5                            | 1.3                              | 3,950   | 780                | 16.5                            | 0.65                             |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

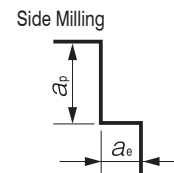
Technical Data

# Milling Conditions for CXES

4 Flutes

| WORK MATERIAL |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                           |                            | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                           |                            |
|---------------|-----------------------|--------------------|---|--------------------|---------------------------|----------------------------|---|--------------------|---------------------------|----------------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 4010-0250     | 1                     | 2.5                | 12,900  | 320                | 2.5                       | 0.2                        | 12,900  | 180                | 2.5                       | 0.05                       |
| 4010-0300     |                       | 3                  | 12,800  | 320                | 3                         | 0.03                       | 12,900  | 180                | 3                         | 0.015                      |
| 4010-0400     |                       | 4                  | 12,600  | 320                | 4                         | 0.02                       | 12,900  | 180                | 4                         | 0.01                       |
| 4010-0500     |                       | 5                  | 12,600  | 320                | 5                         | 0.01                       | 12,900  | 180                | 5                         | 0.005                      |
| 4015-0375     | 1.5                   | 3.75               | 10,500  | 390                | 3.75                      | 0.3                        | 9,300   | 280                | 3.75                      | 0.075                      |
| 4015-0600     |                       | 6                  | 10,200  | 390                | 6                         | 0.03                       | 9,300   | 280                | 6                         | 0.015                      |
| 4020-0500     | 2                     | 5                  | 9,350   | 450                | 5                         | 0.4                        | 7,600   | 390                | 5                         | 0.1                        |
| 4020-0600     |                       | 6                  | 9,250   | 450                | 6                         | 0.06                       | 7,600   | 390                | 6                         | 0.03                       |
| 4020-0800     |                       | 8                  | 9,050   | 450                | 8                         | 0.04                       | 7,600   | 390                | 8                         | 0.02                       |
| 4020-1000     |                       | 10                 | 9,050   | 450                | 10                        | 0.01                       | 7,600   | 390                | 10                        | 0.01                       |
| 4025-0625     | 2.5                   | 6.25               | 8,300   | 540                | 6.25                      | 0.5                        | 6,500   | 510                | 6.25                      | 0.125                      |
| 4025-1000     |                       | 10                 | 8,000   | 540                | 10                        | 0.05                       | 6,500   | 510                | 10                        | 0.025                      |
| 4030-0750     | 3                     | 7.5                | 7,400   | 630                | 7.5                       | 0.6                        | 5,900   | 500                | 7.5                       | 0.3                        |
| 4030-0900     |                       | 9                  | 7,050   | 630                | 9                         | 0.3                        | 5,900   | 500                | 9                         | 0.15                       |
| 4030-1200     |                       | 12                 | 6,350   | 630                | 12                        | 0.06                       | 5,900   | 500                | 12                        | 0.03                       |
| 4030-1500     |                       | 15                 | 6,350   | 630                | 15                        | 0.03                       | 5,900   | 500                | 15                        | 0.015                      |
| 4035-0900     | 3.5                   | 9                  | 6,500   | 640                | 9                         | 0.7                        | 5,200   | 510                | 9                         | 0.35                       |
| 4040-1000     | 4                     | 10                 | 5,900   | 650                | 10                        | 0.8                        | 4,700   | 520                | 10                        | 0.4                        |
| 4040-1200     |                       | 12                 | 5,500   | 650                | 12                        | 0.4                        | 4,700   | 520                | 12                        | 0.2                        |
| 4040-1600     |                       | 16                 | 4,700   | 580                | 16                        | 0.08                       | 4,700   | 520                | 16                        | 0.04                       |
| 4040-2000     |                       | 20                 | 4,700   | 580                | 20                        | 0.04                       | 4,700   | 520                | 20                        | 0.02                       |
| 4045-1150     | 4.5                   | 11.5               | 5,300   | 660                | 11.5                      | 0.9                        | 4,250   | 520                | 11.5                      | 0.45                       |
| 4050-1250     | 5                     | 12.5               | 4,800   | 680                | 12.5                      | 1                          | 3,850   | 530                | 12.5                      | 0.5                        |
| 4050-1500     |                       | 15                 | 4,400   | 680                | 15                        | 0.5                        | 3,850   | 530                | 15                        | 0.25                       |
| 4050-2000     |                       | 20                 | 3,600   | 580                | 20                        | 0.1                        | 3,850   | 530                | 20                        | 0.05                       |
| 4050-2500     |                       | 25                 | 3,600   | 580                | 25                        | 0.05                       | 3,850   | 530                | 25                        | 0.025                      |
| 4055-1400     | 5.5                   | 14                 | 4,350   | 680                | 14                        | 1.1                        | 3,500   | 530                | 14                        | 0.55                       |
| 4060-1500     | 6                     | 15                 | 4,000   | 680                | 15                        | 1.2                        | 3,200   | 540                | 15                        | 0.6                        |
| 4060-1800     |                       | 18                 | 3,600   | 680                | 18                        | 0.6                        | 3,200   | 540                | 18                        | 0.3                        |
| 4060-2400     |                       | 24                 | 2,800   | 560                | 24                        | 0.12                       | 3,200   | 540                | 24                        | 0.06                       |
| 4060-3000     |                       | 30                 | 2,800   | 560                | 30                        | 0.06                       | 3,200   | 540                | 30                        | 0.03                       |
| 4065-1650     | 6.5                   | 16.5               | 3,500   | 660                | 16.5                      | 1.3                        | 2,850   | 530                | 16.5                      | 0.65                       |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Long Neck Square
- Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball
  - Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



## Milling Conditions for CXES

### Side Milling

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                                 |                                  | STAINLESS STEELS<br>SUS304<br>Use water soluble or oil coolant. |                    |                                 |                                  |
|---------------|-----------------------|--------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4070-1050     | 7                     | 10.5               | 3,900   | 1,450              | 10.5                            | 0.7                              | 3,550  | 1,120              | 10.5                            | 0.7                              | 3,550   | 760                | 10.5                            | 0.35                             |
|               |                       | 17.5               | 3,900   | 1,450              | 17.5                            | 1.4                              | 3,550  | 1,120              | 17.5                            | 1.4                              | 3,550   | 760                | 17.5                            | 0.7                              |
| 4070-1750     | 7                     | 17.5               | 3,900   | 1,450              | 17.5                            | 1.4                              | 3,550  | 1,120              | 17.5                            | 1.4                              | 3,550   | 760                | 17.5                            | 0.7                              |
| 4075-1900     | 7.5                   | 19                 | 3,500   | 1,400              | 19                              | 1.5                              | 3,250  | 1,100              | 19                              | 1.5                              | 3,250   | 750                | 19                              | 0.75                             |
| 4080-2000     | 8                     | 20                 | 3,000   | 1,300              | 20                              | 1.6                              | 2,900  | 1,050              | 20                              | 1.6                              | 2,900   | 720                | 20                              | 0.8                              |
| 4080-2400     |                       | 24                 | 2,800   | 1,230              | 24                              | 0.8                              | 2,600  | 1,050              | 24                              | 0.8                              | 2,600   | 600                | 24                              | 0.4                              |
| 4080-3200     |                       | 32                 | 2,400   | 1,090              | 32                              | 0.16                             | 2,000  | 800                | 32                              | 0.16                             | 2,100   | 360                | 32                              | 0.16                             |
| 4080-4000     |                       | 40                 | 2,400   | 1,090              | 40                              | 0.16                             | 2,000  | 800                | 40                              | 0.16                             | 2,100   | 360                | 40                              | 0.16                             |
| 4085-2150     | 8.5                   | 21.5               | 2,550   | 1,200              | 21.5                            | 1.7                              | 2,450  | 1,000              | 21.5                            | 1.7                              | 2,450   | 680                | 21.5                            | 0.85                             |
| 4090-1350     | 9                     | 13.5               | 2,250   | 1,150              | 13.5                            | 0.9                              | 2,150  | 980                | 13.5                            | 0.9                              | 2,150   | 650                | 13.5                            | 0.45                             |
| 4090-2250     |                       | 22.5               | 2,250   | 1,150              | 22.5                            | 1.8                              | 2,150  | 980                | 22.5                            | 1.8                              | 2,150   | 650                | 22.5                            | 0.9                              |
| 4095-2400     | 9.5                   | 24                 | 1,950   | 1,050              | 24                              | 1.9                              | 1,900  | 950                | 24                              | 1.9                              | 1,900   | 620                | 24                              | 0.95                             |
| 4100-2500     | 10                    | 25                 | 1,600   | 1,000              | 25                              | 2                                | 1,500  | 900                | 25                              | 2                                | 1,500   | 580                | 25                              | 1                                |
| 4100-3000     |                       | 30                 | 1,500   | 900                | 30                              | 1                                | 1,500  | 850                | 30                              | 1                                | 1,500   | 580                | 30                              | 0.5                              |
| 4100-4000     |                       | 40                 | 1,300   | 800                | 40                              | 0.2                              | 1,500  | 750                | 40                              | 0.2                              | 1,500   | 580                | 40                              | 0.2                              |
| 4100-5000     |                       | 50                 | 1,300   | 800                | 50                              | 0.2                              | 1,500  | 750                | 50                              | 0.2                              | 1,500   | 580                | 50                              | 0.2                              |
| 4110-1650     | 11                    | 16.5               | 1,400   | 900                | 16.5                            | 1.1                              | 1,350  | 830                | 16.5                            | 1.1                              | 1,350   | 560                | 16.5                            | 0.55                             |
| 4110-2750     |                       | 27.5               | 1,400   | 900                | 27.5                            | 2.2                              | 1,350  | 830                | 27.5                            | 2.2                              | 1,350   | 560                | 27.5                            | 1.1                              |
| 4120-3000     | 12                    | 30                 | 1,200   | 800                | 30                              | 2.4                              | 1,200  | 750                | 30                              | 2.4                              | 1,200   | 540                | 30                              | 1.2                              |
| 4120-3600     |                       | 36                 | 1,150   | 750                | 36                              | 1.2                              | 1,150  | 720                | 36                              | 1.2                              | 1,150   | 540                | 36                              | 0.6                              |
| 4120-4800     |                       | 48                 | 1,050   | 700                | 48                              | 0.24                             | 1,050  | 660                | 48                              | 0.24                             | 1,050   | 500                | 48                              | 0.24                             |
| 4120-6000     |                       | 60                 | 1,050   | 700                | 60                              | 0.24                             | 1,050  | 660                | 60                              | 0.24                             | 1,050   | 500                | 60                              | 0.24                             |
| 4130-1950     | 13                    | 19.5               | 1,100   | 650                | 19.5                            | 1.3                              | 1,100  | 600                | 19.5                            | 1.3                              | 1,000   | 460                | 19.5                            | 0.65                             |
| 4160-4000     | 16                    | 40                 | 1,000   | 500                | 40                              | 3.2                              | 1,000  | 440                | 40                              | 3.2                              | 720   | 340                | 40                              | 1.6                              |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

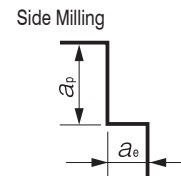
Technical Data



# Milling Conditions for CXES

4 Flutes

| WORK MATERIAL |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                           |                            | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                           |                            |
|---------------|-----------------------|--------------------|---|--------------------|---------------------------|----------------------------|---|--------------------|---------------------------|----------------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 4070-1050     | 7                     | 10.5               | 3,150   | 640                | 10.5                      | 0.7                        | 2,550   | 520                | 10.5                      | 0.35                       |
| 4070-1750     |                       | 17.5               | 3,150   | 640                | 17.5                      | 1.4                        | 2,550   | 520                | 17.5                      | 0.7                        |
| 4075-1900     | 7.5                   | 19                 | 2,850   | 620                | 19                        | 1.5                        | 2,250   | 510                | 19                        | 0.75                       |
| 4080-2000     | 8                     | 20                 | 2,500   | 600                | 20                        | 1.6                        | 2,000   | 500                | 20                        | 0.8                        |
| 4080-2400     |                       | 24                 | 2,350   | 600                | 24                        | 0.8                        | 2,150   | 500                | 24                        | 0.4                        |
| 4080-3200     |                       | 32                 | 2,050   | 530                | 32                        | 0.16                       | 2,150   | 400                | 32                        | 0.08                       |
| 4080-4000     |                       | 40                 | 2,050   | 530                | 40                        | 0.08                       | 2,150   | 400                | 40                        | 0.04                       |
| 4085-2150     | 8.5                   | 21.5               | 2,150   | 550                | 21.5                      | 1.7                        | 1,700   | 490                | 21.5                      | 0.85                       |
| 4090-1350     | 9                     | 13.5               | 1,950   | 520                | 13.5                      | 0.9                        | 1,500   | 480                | 13.5                      | 0.45                       |
| 4090-2250     |                       | 22.5               | 1,950   | 520                | 22.5                      | 1.8                        | 1,500   | 480                | 22.5                      | 0.9                        |
| 4095-2400     | 9.5                   | 24                 | 1,750   | 480                | 24                        | 1.9                        | 1,350   | 470                | 24                        | 0.95                       |
| 4100-2500     | 10                    | 25                 | 1,500   | 430                | 25                        | 2                          | 1,200   | 450                | 25                        | 1                          |
| 4100-3000     |                       | 30                 | 1,500   | 430                | 30                        | 1                          | 1,200   | 450                | 30                        | 0.5                        |
| 4100-4000     |                       | 40                 | 1,500   | 430                | 40                        | 0.2                        | 1,200   | 450                | 40                        | 0.1                        |
| 4100-5000     |                       | 50                 | 1,500   | 430                | 50                        | 0.1                        | 1,200   | 450                | 50                        | 0.05                       |
| 4110-1650     | 11                    | 16.5               | 1,250   | 380                | 16.5                      | 1.1                        | 1,060   | 430                | 16.5                      | 0.55                       |
| 4110-2750     |                       | 27.5               | 1,250   | 380                | 27.5                      | 2.2                        | 1,060   | 430                | 27.5                      | 1.1                        |
| 4120-3000     | 12                    | 30                 | 1,000   | 320                | 30                        | 2.4                        | 960   | 420                | 30                        | 1.2                        |
| 4120-3600     |                       | 36                 | 1,000   | 320                | 36                        | 1.2                        | 930   | 400                | 36                        | 0.6                        |
| 4120-4800     |                       | 48                 | 1,000   | 320                | 48                        | 0.24                       | 870   | 360                | 48                        | 0.12                       |
| 4120-6000     |                       | 60                 | 1,000   | 320                | 60                        | 0.12                       | 870   | 360                | 60                        | 0.06                       |
| 4130-1950     | 13                    | 19.5               | 1,000   | 260                | 19.5                      | 1.3                        | 890   | 350                | 19.5                      | 0.65                       |
| 4160-4000     | 16                    | 40                 | 1,000   | 220                | 40                        | 3.2                        | 720   | 280                | 40                        | 1.6                        |



- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Long Neck Square
- Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball
  - Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
  - Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for CXES

### Slotting

| WORK MATERIAL       |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                                 | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                                 | STAINLESS STEELS<br>SUS304<br>Use water soluble or oil coolant. |                    |                                 |
|---------------------|-----------------------|--------------------|---|--------------------|---------------------------------|--|--------------------|---------------------------------|---|--------------------|---------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 4010-0250           | 1                     | 2.5                | 18,000  | 200                | 1                               | 18,000   | 200                | 1                               | 14,500  | 220                | 0.5                             |
| 4010-0300           |                       | 3                  | 18,000  | 190                | 0.5※                            | 18,000   | 190                | 0.5※                            | 14,300  | 210                | 0.25※                           |
| 4010-0400           |                       | 4                  | 18,000  | 170                | 0.5※                            | 18,000   | 170                | 0.5※                            | 12,500  | 190                | 0.25※                           |
| 4010-0500           |                       | 5                  | 18,000  | 170                | 0.5※                            | 18,000   | 170                | 0.5※                            | 12,500  | 190                | 0.25※                           |
| 4015-0375           | 1.5                   | 3.75               | 13,500  | 320                | 1.5                             | 13,500   | 280                | 1.5                             | 13,300  | 240                | 0.75                            |
| 4015-0600           |                       | 6                  | 13,500  | 290                | 0.75※                           | 13,500   | 250                | 0.75※                           | 12,700  | 210                | 0.375※                          |
| 4020-0500           | 2                     | 5                  | 11,000  | 460                | 2                               | 11,000   | 320                | 2                               | 12,200  | 260                | 1                               |
| 4020-0600           |                       | 6                  | 11,000  | 440                | 1※                              | 11,000   | 310                | 1※                              | 12,000  | 240                | 0.5※                            |
| 4020-0800           |                       | 8                  | 11,000  | 400                | 1※                              | 11,000   | 290                | 1※                              | 11,600  | 200                | 0.5※                            |
| 4020-1000           |                       | 10                 | 11,000  | 400                | 1※                              | 11,000   | 290                | 1※                              | 11,600  | 200                | 0.5※                            |
| 4025-0625           | 2.5                   | 6.25               | 9,500   | 540                | 2.5                             | 9,500  | 360                | 2.5                             | 11,000  | 310                | 1.25                            |
| 4025-1000           |                       | 10                 | 9,500   | 480                | 1.25※                           | 9,500  | 330                | 1.25※                           | 10,400  | 250                | 0.625※                          |
| 4030-0750           | 3                     | 7.5                | 8,500   | 600                | 3                               | 8,500  | 400                | 3                               | 10,000  | 360                | 1.5                             |
| 4030-0900           |                       | 9                  | 8,500   | 550                | 3                               | 8,500  | 360                | 3                               | 9,100   | 310                | 1.5                             |
| 4030-1200           |                       | 12                 | 8,500   | 450                | 1.5※                            | 8,500  | 280                | 1.5※                            | 7,300   | 210                | 0.75※                           |
| 4030-1500           |                       | 15                 | 8,500   | 450                | 1.5※                            | 8,500  | 280                | 1.5※                            | 7,300   | 210                | 0.75※                           |
| 4035-0900           | 3.5                   | 9                  | 7,800   | 620                | 3.5                             | 7,500  | 420                | 3.5                             | 8,600   | 380                | 1.75                            |
| 4040-1000           | 4                     | 10                 | 7,200   | 650                | 4                               | 6,700  | 450                | 4                               | 7,500   | 400                | 2                               |
| 4040-1200           |                       | 12                 | 7,200   | 580                | 4                               | 6,700  | 400                | 4                               | 6,600   | 320                | 2                               |
| 4040-1600           |                       | 16                 | 7,200   | 440                | 2※                              | 6,700  | 300                | 2※                              | 4,800   | 200                | 1※                              |
| 4040-2000           |                       | 20                 | 7,200   | 440                | 2※                              | 6,700  | 300                | 2※                              | 4,800   | 200                | 1※                              |
| 4045-1150           | 4.5                   | 11.5               | 6,550   | 670                | 4.5                             | 6,000  | 470                | 4.5                             | 6,300   | 430                | 2.25                            |
| 4050-1250           | 5                     | 12.5               | 6,000   | 700                | 5                               | 5,400  | 500                | 5                               | 5,400   | 460                | 2.5                             |
| 4050-1500           |                       | 15                 | 6,000   | 600                | 5                               | 5,400  | 430                | 5                               | 4,600   | 350                | 2.5                             |
| 4050-2000           |                       | 20                 | 6,000   | 400                | 2.5※                            | 5,400  | 290                | 2.5※                            | 3,000   | 170                | 1.25※                           |
| 4050-2500           |                       | 25                 | 6,000   | 400                | 2.5※                            | 5,400  | 290                | 2.5※                            | 3,000   | 170                | 1.25※                           |
| 4055-1400           | 5.5                   | 14                 | 5,450   | 700                | 5.5                             | 4,900  | 500                | 5.5                             | 4,900   | 460                | 2.75                            |
| Milling Amount (mm) |                       |                    | a <sub>p</sub> =1D<br>※ a <sub>p</sub> =0.5D                |                    |                                 | a <sub>p</sub> =1D<br>※ a <sub>p</sub> =0.5D               |                    |                                 | a <sub>p</sub> =0.5D<br>※ a <sub>p</sub> =0.25D                 |                    |                                 |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

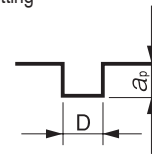
Technical Data

# Milling Conditions for CXES

4 Flutes

| WORK MATERIAL       |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC)                               |                    |                                 | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                                 |
|---------------------|-----------------------|--------------------|---|--------------------|---------------------------------|---|--------------------|---------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 4010-0250           | 1                     | 2.5                | 12,900  | 130                | 1                               | 12,900  | 50                 | 0.3※                            |
| 4010-0300           |                       | 3                  | 12,800  | 120                | 0.5※2                           | N/A   | N/A                | N/A                             |
| 4010-0400           |                       | 4                  | 12,100  | 100                | 0.5※2                           | N/A   | N/A                | N/A                             |
| 4010-0500           |                       | 5                  | N/A   | N/A                | N/A                             | N/A   | N/A                | N/A                             |
| 4015-0375           | 1.5                   | 3.75               | 10,500  | 180                | 1.5                             | 10,500  | 100                | 0.45※                           |
| 4015-0600           |                       | 6                  | 10,200  | 150                | 0.75※2                          | N/A   | N/A                | N/A                             |
| 4020-0500           | 2                     | 5                  | 9,350   | 220                | 2                               | 9,350   | 150                | 0.6※                            |
| 4020-0600           |                       | 6                  | 9,300   | 200                | 1※2                             | N/A   | N/A                | N/A                             |
| 4020-0800           |                       | 8                  | 8,600   | 160                | 1※2                             | N/A   | N/A                | N/A                             |
| 4020-1000           |                       | 10                 | N/A   | N/A                | N/A                             | N/A   | N/A                | N/A                             |
| 4025-0625           | 2.5                   | 6.25               | 8,300   | 270                | 2.5                             | 8,300   | 240                | 0.75※                           |
| 4025-1000           |                       | 10                 | 8,000   | 210                | 1.25※2                          | N/A   | N/A                | N/A                             |
| 4030-0750           | 3                     | 7.5                | 7,400   | 320                | 3                               | 7,400   | 360                | 1.5                             |
| 4030-0900           |                       | 9                  | 7,050   | 270                | 3                               | N/A   | N/A                | N/A                             |
| 4030-1200           |                       | 12                 | 6,350   | 170                | 1.5※2                           | N/A   | N/A                | N/A                             |
| 4030-1500           |                       | 15                 | N/A   | N/A                | N/A                             | N/A   | N/A                | N/A                             |
| 4035-0900           | 3.5                   | 9                  | 6,500   | 350                | 3.5                             | 6,500   | 370                | 1.75                            |
| 4040-1000           | 4                     | 10                 | 5,900   | 390                | 4                               | 5,900   | 380                | 2                               |
| 4040-1200           |                       | 12                 | 5,500   | 300                | 4                               | N/A   | N/A                | N/A                             |
| 4040-1600           |                       | 16                 | 4,700   | 160                | 2※2                             | N/A   | N/A                | N/A                             |
| 4040-2000           |                       | 20                 | N/A   | N/A                | N/A                             | N/A   | N/A                | N/A                             |
| 4045-1150           | 4.5                   | 11.5               | 5,300   | 410                | 4.5                             | 5,300   | 390                | 2.25                            |
| 4050-1250           | 5                     | 12.5               | 4,800   | 440                | 5                               | 4,800   | 410                | 2.5                             |
| 4050-1500           |                       | 15                 | 4,400   | 320                | 5                               | N/A   | N/A                | N/A                             |
| 4050-2000           |                       | 20                 | 3,600   | 160                | 2.5※2                           | N/A   | N/A                | N/A                             |
| 4050-2500           |                       | 25                 | N/A   | N/A                | N/A                             | N/A   | N/A                | N/A                             |
| 4055-1400           | 5.5                   | 14                 | 4,350   | 440                | 5.5                             | 4,350   | 420                | 2.75                            |
| Milling Amount (mm) |                       |                    | ※1 a <sub>p</sub> =1D<br>※2 a <sub>p</sub> =0.8D<br>※3 a <sub>p</sub> =0.5D |                    |                                 | ※1 a <sub>p</sub> =0.5D<br>※2 a <sub>p</sub> =0.3D  |                    |                                 |

Slotting



D : Outside Diameter(mm)

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Long Neck Square
- Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball
  - Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
  - Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Milling Conditions for CXES

Slotting

| WORK MATERIAL       |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                                 | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                                 | STAINLESS STEELS<br>SUS304<br>Use water soluble or oil coolant. |                    |                                 |
|---------------------|-----------------------|--------------------|---|--------------------|---------------------------------|--|--------------------|---------------------------------|---|--------------------|---------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 4060-1500           | 6                     | 15                 | 5,000   | 700                | 6                               | 4,500  | 500                | 6                               | 4,500   | 460                | 3                               |
| 4060-1800           |                       | 18                 | 5,000   | 560                | 6                               | 4,500  | 410                | 6                               | 3,700   | 320                | 3                               |
| 4060-2400           |                       | 24                 | 5,000   | 280                | 3※                              | 4,500  | 230                | 3※                              | 2,100   | 150                | 1.5※                            |
| 4060-3000           |                       | 30                 | 5,000   | 280                | 3※                              | 4,500  | 230                | 3※                              | 2,100   | 150                | 1.5※                            |
| 4065-1650           | 6.5                   | 16.5               | 4,400   | 650                | 6.5                             | 3,950  | 450                | 6.5                             | 3,950   | 420                | 3.25                            |
| 4070-1050           | 7                     | 10.5               | 3,900   | 300                | 7                               | 3,550  | 200                | 7                               | 3,550   | 200                | 3.5                             |
| 4070-1750           |                       | 17.5               | 3,900   | 600                | 7                               | 3,550  | 400                | 7                               | 3,550   | 390                | 3.5                             |
| 4075-1900           | 7.5                   | 19                 | 3,500   | 550                | 7.5                             | 3,250  | 380                | 7.5                             | 3,250   | 380                | 3.75                            |
| 4080-2000           | 8                     | 20                 | 3,000   | 500                | 8                               | 2,900  | 360                | 8                               | 2,900   | 360                | 4                               |
| 4080-2400           |                       | 24                 | 2,800   | 330                | 8                               | 2,600  | 260                | 8                               | 2,600   | 240                | 4                               |
| 4080-3200           |                       | 32                 | 2,400   | 230                | 4※                              | 2,000  | 180                | 4※                              | 2,000   | 130                | 2※                              |
| 4080-4000           |                       | 40                 | 2,400   | 230                | 4※                              | 2,000  | 180                | 4※                              | 2,000   | 130                | 2※                              |
| 4085-2150           | 8.5                   | 21.5               | 2,550   | 450                | 8.5                             | 2,450  | 330                | 8.5                             | 2,450   | 310                | 4.25                            |
| 4090-1350           | 9                     | 13.5               | 2,250   | 210                | 9                               | 2,150  | 160                | 9                               | 2,150   | 140                | 4.5                             |
| 4090-2250           |                       | 22.5               | 2,250   | 420                | 9                               | 2,150  | 300                | 9                               | 2,150   | 260                | 4.5                             |
| 4095-2400           | 9.5                   | 24                 | 1,950   | 400                | 9.5                             | 1,900  | 300                | 9.5                             | 1,900   | 250                | 4.75                            |
| 4100-2500           | 10                    | 25                 | 1,600   | 380                | 10                              | 1,500  | 270                | 10                              | 1,500   | 220                | 5                               |
| 4100-3000           |                       | 30                 | 1,500   | 250                | 10                              | 1,500  | 180                | 10                              | 1,500   | 190                | 5                               |
| 4100-4000           |                       | 40                 | 1,300   | 180                | 5※                              | 1,500  | 150                | 5※                              | 1,500   | 130                | 2.5※                            |
| 4100-5000           |                       | 50                 | 1,300   | 180                | 5※                              | 1,500  | 150                | 5※                              | 1,500   | 130                | 2.5※                            |
| 4110-1650           | 11                    | 16.5               | 1,400   | 170                | 11                              | 1,350  | 120                | 11                              | 1,350   | 100                | 5.5                             |
| 4110-2750           |                       | 27.5               | 1,400   | 340                | 11                              | 1,350  | 240                | 11                              | 1,350   | 200                | 5.5                             |
| 4120-3000           | 12                    | 30                 | 1,200   | 300                | 12                              | 1,200  | 210                | 12                              | 1,200   | 180                | 6                               |
| 4120-3600           |                       | 36                 | 1,150   | 200                | 12                              | 1,150  | 140                | 12                              | 1,150   | 150                | 6                               |
| 4120-4800           |                       | 48                 | 1,050   | 160                | 6※                              | 1,050  | 120                | 6※                              | 1,050   | 100                | 3※                              |
| 4120-6000           |                       | 60                 | 1,050   | 160                | 6※                              | 1,050  | 120                | 6※                              | 1,050   | 100                | 3※                              |
| 4130-1950           | 13                    | 19.5               | 1,100   | 190                | 13                              | 1,100  | 90                 | 13                              | 1,000   | 80                 | 6.5                             |
| 4160-4000           | 16                    | 40                 | 1,000   | 400                | 8※                              | 1,000  | 280                | 8※                              | 720   | 240                | 4※                              |
| Milling Amount (mm) |                       |                    | a <sub>p</sub> =1D<br>※ a <sub>p</sub> =0.5D                |                    |                                 | a <sub>p</sub> =1D<br>※ a <sub>p</sub> =0.5D               |                    |                                 | a <sub>p</sub> =0.5D<br>※ a <sub>p</sub> =0.25D                 |                    |                                 |

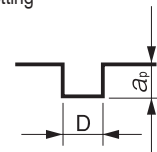
- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

# Milling Conditions for CXES

4 Flutes

| WORK MATERIAL       |                       |                    | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC)                            |                    |                                 | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                                 |
|---------------------|-----------------------|--------------------|--|--------------------|---------------------------------|---|--------------------|---------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                                       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 4060-1500           | 6                     | 15                 | 4,000  | 440                | 6                               | 4,000   | 440                | 3                               |
| 4060-1800           |                       | 18                 | 3,600  | 290                | 6                               | N/A   | N/A                | N/A                             |
| 4060-2400           |                       | 24                 | 2,800  | 140                | 3*2                             | N/A   | N/A                | N/A                             |
| 4060-3000           |                       | 30                 | N/A  | N/A                | N/A                             | N/A   | N/A                | N/A                             |
| 4065-1650           | 6.5                   | 16.5               | 3,500  | 420                | 6.5                             | 3,500   | 400                | 3.25                            |
| 4070-1050           | 7                     | 10.5               | 3,150  | 190                | 7                               | 3,150   | 190                | 3.5                             |
| 4070-1750           |                       | 17.5               | 3,150  | 410                | 7                               | 3,150   | 380                | 3.5                             |
| 4075-1900           | 7.5                   | 19                 | 2,850  | 400                | 7.5                             | 2,850   | 370                | 3.75                            |
| 4080-2000           | 8                     | 20                 | 2,500  | 390                | 8                               | 2,500   | 340                | 4                               |
| 4080-2400           |                       | 24                 | 2,350  | 200                | 8                               | N/A   | N/A                | N/A                             |
| 4080-3200           |                       | 32                 | 2,050  | 110                | 4*2                             | N/A   | N/A                | N/A                             |
| 4080-4000           |                       | 40                 | N/A  | N/A                | N/A                             | N/A   | N/A                | N/A                             |
| 4085-2150           | 8.5                   | 21.5               | 2,150  | 330                | 8.5                             | 2,150   | 300                | 4.25                            |
| 4090-1350           | 9                     | 13.5               | 1,950  | 150                | 9                               | 1,950   | 140                | 4.5                             |
| 4090-2250           |                       | 22.5               | 1,950  | 300                | 9                               | 1,950   | 270                | 4.5                             |
| 4095-2400           | 9.5                   | 24                 | 1,750  | 270                | 9.5                             | 1,750   | 270                | 4.75                            |
| 4100-2500           | 10                    | 25                 | 1,500  | 220                | 10                              | 1,500   | 240                | 5                               |
| 4100-3000           |                       | 30                 | 1,500  | 180                | 8*1                             | N/A   | N/A                | N/A                             |
| 4100-4000           |                       | 40                 | 1,200  | 90                 | 5*2                             | N/A   | N/A                | N/A                             |
| 4100-5000           |                       | 50                 | N/A  | N/A                | N/A                             | N/A   | N/A                | N/A                             |
| 4110-1650           | 11                    | 16.5               | 1,250  | 100                | 11                              | 1,350   | 110                | 5.5                             |
| 4110-2750           |                       | 27.5               | 1,250  | 200                | 11                              | 1,350   | 230                | 5.5                             |
| 4120-3000           | 12                    | 30                 | 1,000  | 180                | 12                              | 1,200   | 220                | 6                               |
| 4120-3600           |                       | 36                 | 1,000  | 140                | 9.6*1                           | N/A   | N/A                | N/A                             |
| 4120-4800           |                       | 48                 | 800  | 70                 | 6*2                             | N/A   | N/A                | N/A                             |
| 4120-6000           |                       | 60                 | N/A  | N/A                | N/A                             | N/A   | N/A                | N/A                             |
| 4130-1950           | 13                    | 19.5               | 1,000  | 80                 | 13                              | 1,100   | 90                 | 6.5                             |
| 4160-4000           | 16                    | 40                 | 1,000  | 240                | 8*2                             | 1,000   | 220                | 4.8*                            |
| Milling Amount (mm) |                       |                    | a <sub>p</sub> =1D<br>※1 a <sub>p</sub> =0.8D<br>※2 a <sub>p</sub> =0.5D |                    |                                 | a <sub>p</sub> =0.5D<br>※ a <sub>p</sub> =0.3D      |                    |                                 |

Slotting



D : Outside Diameter(mm)

- ∅3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Long Neck Square
- Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball
  - Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
  - Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

**Note:**

- Decrease both spindle speed and feed rate proportionally in case of chattering.
- These milling parameters are calculated based on the shortest overhang length. Longer overhangs may require an adjustment to the milling parameters.
- Reduce the milling amount and feed rate in accordance with required milling precision.
- Every coolant offers stable milling.
- Recommend water soluble or oil coolant for Stainless Steels and Copper.

|                           |               |
|---------------------------|---------------|
| ∅3mm Shank<br>V Series    |               |
| UDC-PCD<br>Series         |               |
| CBN<br>Series             |               |
| <b>Square</b>             | <b>Square</b> |
| Long Neck<br>Square       |               |
| Radius                    | <b>Radius</b> |
| Long Neck<br>Radius       |               |
| Taper Neck<br>Radius      |               |
| Ball / Long<br>Shank Ball | <b>Ball</b>   |
| Long Neck<br>Ball         |               |
| Taper Neck<br>Ball        |               |
| Taper                     | <b>Taper</b>  |
| Barrel                    |               |
| Spiral<br>V Cutter        |               |
| Drill                     |               |
| Technical Data            |               |

## Milling Example CXES $\phi 10$

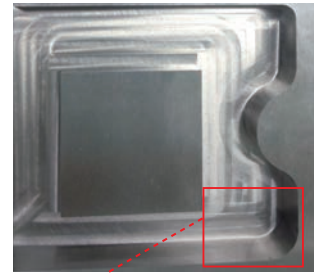
S55C

Roughing and finishing with a single tool

Size : 105 mm  $\times$  92 mm  $\times$  20 mm

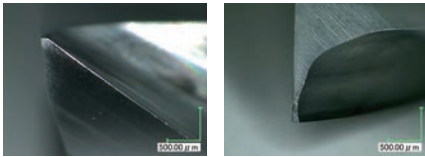
| Tool             | Roughing                |                         | Finishing               |              |
|------------------|-------------------------|-------------------------|-------------------------|--------------|
|                  | Conventional 4 Flutes   | CXES 4100-2500          | CXES 4100-2500          |              |
| Milling Part     | Side / Slot             |                         | Bottom                  | Side         |
| Spindle Speed    | 2,600 min <sup>-1</sup> | 2,500 min <sup>-1</sup> | 1,600 min <sup>-1</sup> |              |
| Feed Rate        | 525 mm/min              | 1,500 mm/min            | 380 mm/min              | 1,000 mm/min |
| $a_p$            | 20 mm                   | 19.9 mm                 | 0.1 mm                  | 0.1 mm       |
| $a_e$            | 0.7 mm                  | 1.2 mm                  | 0.4 mm                  | 0.1 mm       |
| Coolant          | Oil                     |                         | Oil                     |              |
| Milling Distance | —                       | 11.5 m                  | 1.5 m                   | 0.7 m        |
| Efficiency*      | 1                       | <b>4.8</b>              | —                       |              |

\* Efficiency : Feed Rate  $\times$  Axial Depth  $\times$  Radial Depth

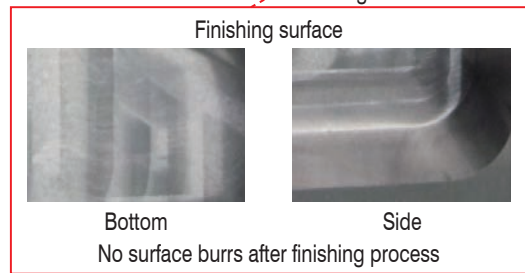


Enlarged view

**4.8 times** milling efficiency compared to conventional 4 flutes when roughing



Total Milling Distance 21 m



## Milling Example CXES $\phi 6$

SUS304

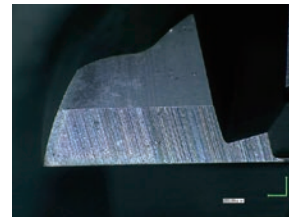
| Tool            | CXES4060-1500                      |   |
|-----------------|------------------------------------|---|
|                 | Roughing                           | Finishing   |
| Milling Method  | Roughing                           | Finishing   |
| Spindle Speed   | 4,500 min <sup>-1</sup>            | 4,500 min <sup>-1</sup>                             |
| Feed Rate       | 810 mm/min                         | 400 mm/min  |
| $a_p$           | 15 mm                              | 15 mm   |
| $a_e$           | 0.6 mm                             | 2.5 mm<br>(Standing Wall Finishing Allowance 0.1mm) |
| Overhang Length | 20 mm                              | 20 mm   |
| Coolant         | Water Soluble<br>(Through Spindle) | Water Soluble<br>(Through Spindle)                  |
| Cycle Time      | 1:11:29                            | 0:18:43   |

CXES Milling Video

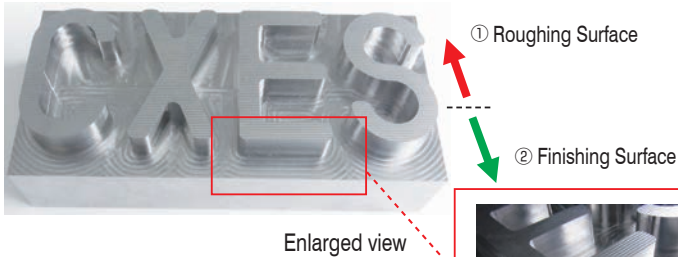


Tool Wearing after Roughing Process

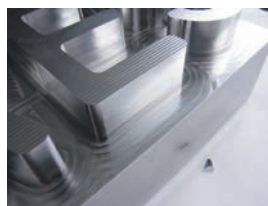
End Profile



Peripheral Cutting Edge



Enlarged view



Smooth Side Finishing

4 Flutes

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 6 \sim \phi 12$

# CESUS

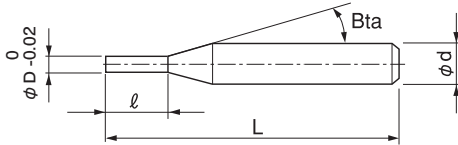


Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ★                               | ○                                |                 |        |        |        |        | ○         |                 |          | ○      |          |                       | ○               | ○                     |                  |                                       |

## Features

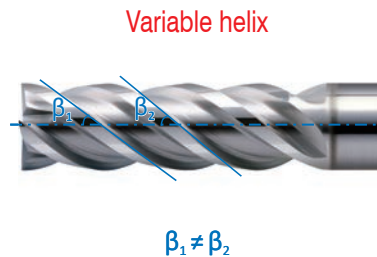
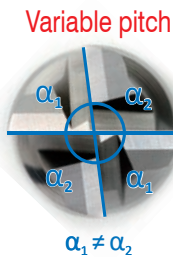
**4 Flute Highly Efficient Square End Mills for stainless steels.**  
**Variable pitch & variable helix designed for milling stainless steels offers higher efficiency milling.**  
**New coating 'UTSCOAT' with excellent adhesion offers high resistance to breakage.**



The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

## Design features

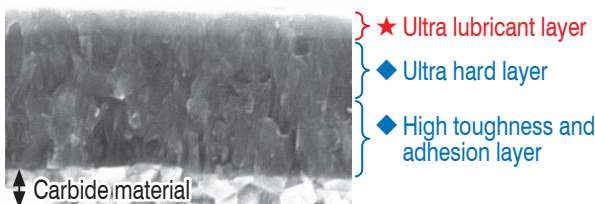
Variable pitch & variable helix designed for milling stainless steels.



- Minimizes chattering
- Stable milling under highly efficient conditions

## Features of UTSCOAT

Improve the resistance to adhesion by adding a highly lubricant layer onto the high hardness and high toughness UTSCOAT.



- Reduce adhesion
- High resistance to breakage with high lubricity



Total 21 models

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|---------------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| CESUS 4060-0900 | 6                         | 9                    | —                     | 60               | 6                       | 8,500                    |
| CESUS 4060-1300 |                           | 13                   |                       | 60               | 6                       | 8,500                    |
| CESUS 4060-1800 |                           | 18                   |                       | 60               | 6                       | 9,350                    |
| CESUS 4070-1050 | 7                         | 10.5                 | 16°                   | 70               | 8                       | 10,500                   |
| CESUS 4070-1600 |                           | 16                   |                       | 70               | 8                       | 10,500                   |
| CESUS 4070-2100 |                           | 21                   |                       | 70               | 8                       | 11,550                   |
| CESUS 4080-1200 | 8                         | 12                   | —                     | 70               | 8                       | 10,500                   |
| CESUS 4080-1900 |                           | 19                   |                       | 70               | 8                       | 10,500                   |
| CESUS 4080-2400 |                           | 24                   |                       | 70               | 8                       | 11,550                   |
| CESUS 4090-1350 | 9                         | 13.5                 | 16°                   | 80               | 10                      | 12,500                   |
| CESUS 4090-1900 |                           | 19                   |                       | 80               | 10                      | 12,500                   |
| CESUS 4090-2700 |                           | 27                   |                       | 80               | 10                      | 13,750                   |
| CESUS 4100-1500 | 10                        | 15                   | —                     | 80               | 10                      | 12,500                   |
| CESUS 4100-2200 |                           | 22                   |                       | 80               | 10                      | 12,500                   |
| CESUS 4100-3000 |                           | 30                   |                       | 80               | 10                      | 13,750                   |
| CESUS 4110-1650 | 11                        | 16.5                 | 16°                   | 100              | 12                      | 17,800                   |
| CESUS 4110-2200 |                           | 22                   |                       | 100              | 12                      | 17,800                   |
| CESUS 4110-3300 |                           | 33                   |                       | 100              | 12                      | 19,580                   |
| CESUS 4120-1800 | 12                        | 18                   | —                     | 100              | 12                      | 17,800                   |
| CESUS 4120-2600 |                           | 26                   |                       | 100              | 12                      | 17,800                   |
| CESUS 4120-3600 |                           | 36                   |                       | 100              | 12                      | 19,580                   |

4 Flutes

$\phi 3$ mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

## Milling Conditions for CESUS

### Side Milling

| WORK MATERIAL       |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                                 |                                  | STAINLESS STEELS<br>SUS304<br>Use water soluble or oil coolant. |                    |                                 |                                  |
|---------------------|-----------------------|--------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4060-0900           | 6                     | 9                  | 6,000   | 1,600              | 9                               | 1.2                              | 6,000  | 1,100              | 9                               | 1.2                              | 6,000   | 1,100              | 9                               | 1.2                              |
| 4060-1300           |                       | 13                 | 6,000   | 1,600              | 13                              | 1.2                              | 6,000  | 1,100              | 13                              | 1.2                              | 6,000   | 1,100              | 13                              | 1.2                              |
| 4060-1800           |                       | 18                 | 6,000   | 1,170              | 18                              | 1.2                              | 4,800  | 800                | 18                              | 1.2                              | 4,800   | 800                | 18                              | 1.2                              |
| 4070-1050           | 7                     | 10.5               | 5,000   | 1,450              | 10.5                            | 1.4                              | 5,000  | 1,025              | 10.5                            | 1.4                              | 5,000   | 1,025              | 10.5                            | 1.4                              |
| 4070-1600           |                       | 16                 | 5,000   | 1,450              | 16                              | 1.4                              | 5,000  | 1,025              | 16                              | 1.4                              | 5,000   | 1,025              | 16                              | 1.4                              |
| 4070-2100           |                       | 21                 | 5,000   | 1,060              | 21                              | 1.4                              | 4,000  | 750                | 21                              | 1.4                              | 4,000   | 750                | 21                              | 1.4                              |
| 4080-1200           | 8                     | 12                 | 4,300   | 1,300              | 12                              | 1.6                              | 4,300  | 950                | 12                              | 1.6                              | 4,300   | 950                | 12                              | 1.6                              |
| 4080-1900           |                       | 19                 | 4,300   | 1,300              | 19                              | 1.6                              | 4,300  | 950                | 19                              | 1.6                              | 4,300   | 950                | 19                              | 1.6                              |
| 4080-2400           |                       | 24                 | 4,300   | 950                | 24                              | 1.6                              | 3,400  | 695                | 24                              | 1.6                              | 3,400   | 695                | 24                              | 1.6                              |
| 4090-1350           | 9                     | 13.5               | 3,700   | 1,150              | 13.5                            | 1.8                              | 3,700  | 875                | 13.5                            | 1.8                              | 3,700   | 875                | 13.5                            | 1.8                              |
| 4090-1900           |                       | 19                 | 3,700   | 1,150              | 19                              | 1.8                              | 3,700  | 875                | 19                              | 1.8                              | 3,700   | 875                | 19                              | 1.8                              |
| 4090-2700           |                       | 27                 | 3,700   | 840                | 27                              | 1.8                              | 2,960  | 640                | 27                              | 1.8                              | 2,960   | 640                | 27                              | 1.8                              |
| 4100-1500           | 10                    | 15                 | 3,200   | 1,000              | 15                              | 2                                | 3,200  | 800                | 15                              | 2                                | 3,200   | 800                | 15                              | 2                                |
| 4100-2200           |                       | 22                 | 3,200   | 1,000              | 22                              | 2                                | 3,200  | 800                | 22                              | 2                                | 3,200   | 800                | 22                              | 2                                |
| 4100-3000           |                       | 30                 | 3,200   | 730                | 30                              | 2                                | 2,650  | 580                | 30                              | 2                                | 2,650   | 580                | 30                              | 2                                |
| 4110-1650           | 11                    | 16.5               | 2,900   | 900                | 16.5                            | 2.2                              | 2,900  | 725                | 16.5                            | 2.2                              | 2,900   | 725                | 16.5                            | 2.2                              |
| 4110-2200           |                       | 22                 | 2,900   | 900                | 22                              | 2.2                              | 2,900  | 725                | 22                              | 2.2                              | 2,900   | 725                | 22                              | 2.2                              |
| 4110-3300           |                       | 33                 | 2,900   | 650                | 33                              | 2.2                              | 2,400  | 530                | 33                              | 2.2                              | 2,400   | 530                | 33                              | 2.2                              |
| 4120-1800           | 12                    | 18                 | 2,650   | 800                | 18                              | 2.4                              | 2,650  | 650                | 18                              | 2.4                              | 2,650   | 650                | 18                              | 2.4                              |
| 4120-2600           |                       | 26                 | 2,650   | 800                | 26                              | 2.4                              | 2,650  | 650                | 26                              | 2.4                              | 2,650   | 650                | 26                              | 2.4                              |
| 4120-3600           |                       | 36                 | 2,650   | 580                | 36                              | 2.4                              | 2,200  | 475                | 36                              | 2.4                              | 2,200   | 475                | 36                              | 2.4                              |
| Milling Amount (mm) |                       |                    | a <sub>p</sub> : All Flute<br>a <sub>e</sub> : 0.2D         |                    |                                 |                                  | a <sub>p</sub> : All Flute<br>a <sub>e</sub> : 0.2D        |                    |                                 |                                  | a <sub>p</sub> : All Flute<br>a <sub>e</sub> : 0.2D             |                    |                                 |                                  |

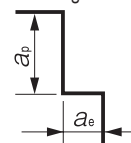
### Slotting

| WORK MATERIAL       |                       |                    | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                                 | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                                 | STAINLESS STEELS<br>SUS304<br>Use water soluble or oil coolant. |                    |                                 |
|---------------------|-----------------------|--------------------|---|--------------------|---------------------------------|--|--------------------|---------------------------------|---|--------------------|---------------------------------|
| Model Number        | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 4060-0900           | 6                     | 9                  | 6,000   | 700                | 6                               | 6,000  | 700                | 6                               | 6,000   | 700                | 6                               |
| 4060-1300           |                       | 13                 | 6,000   | 700                | 6                               | 6,000  | 700                | 6                               | 6,000   | 700                | 6                               |
| 4060-1800           |                       | 18                 | 6,000   | 560                | 6                               | 4,200  | 350                | 6                               | 4,200   | 350                | 6                               |
| 4070-1050           | 7                     | 10.5               | 5,000   | 625                | 7                               | 5,000  | 625                | 7                               | 5,000   | 625                | 7                               |
| 4070-1600           |                       | 16                 | 5,000   | 625                | 7                               | 5,000  | 625                | 7                               | 5,000   | 625                | 7                               |
| 4070-2100           |                       | 21                 | 5,000   | 500                | 7                               | 3,500  | 300                | 7                               | 3,500   | 300                | 7                               |
| 4080-1200           | 8                     | 12                 | 4,300   | 550                | 8                               | 4,300  | 550                | 8                               | 4,000   | 500                | 8                               |
| 4080-1900           |                       | 19                 | 4,300   | 550                | 8                               | 4,300  | 550                | 8                               | 4,000   | 500                | 8                               |
| 4080-2400           |                       | 24                 | 4,300   | 440                | 8                               | 3,000  | 275                | 8                               | 3,000   | 275                | 8                               |
| 4090-1350           | 9                     | 13.5               | 3,500   | 475                | 9                               | 3,500  | 475                | 9                               | 3,150   | 430                | 9                               |
| 4090-1900           |                       | 19                 | 3,500   | 475                | 9                               | 3,500  | 475                | 9                               | 3,150   | 430                | 9                               |
| 4090-2700           |                       | 27                 | 3,500   | 380                | 9                               | 2,450  | 240                | 9                               | 2,450   | 240                | 9                               |
| 4100-1500           | 10                    | 15                 | 2,900   | 400                | 10                              | 2,900  | 400                | 10                              | 2,900   | 400                | 10                              |
| 4100-2200           |                       | 22                 | 2,900   | 400                | 10                              | 2,900  | 400                | 10                              | 2,900   | 400                | 10                              |
| 4100-3000           |                       | 30                 | 2,900   | 320                | 10                              | 2,000  | 200                | 10                              | 2,000   | 200                | 10                              |
| 4110-1650           | 11                    | 16.5               | 2,650   | 340                | 11                              | 2,650  | 340                | 11                              | 2,380   | 300                | 11                              |
| 4110-2200           |                       | 22                 | 2,650   | 340                | 11                              | 2,650  | 340                | 11                              | 2,380   | 300                | 11                              |
| 4110-3300           |                       | 33                 | 2,650   | 270                | 11                              | 1,820  | 170                | 11                              | 1,820   | 170                | 11                              |
| 4120-1800           | 12                    | 18                 | 2,420   | 300                | 12                              | 2,420  | 300                | 12                              | 2,420   | 300                | 12                              |
| 4120-2600           |                       | 26                 | 2,420   | 300                | 12                              | 2,420  | 300                | 12                              | 2,420   | 300                | 12                              |
| 4120-3600           |                       | 36                 | 2,420   | 240                | 12                              | 1,650  | 150                | 12                              | 1,650   | 150                | 12                              |
| Milling Amount (mm) |                       |                    | a <sub>p</sub> : 1D   |                    |                                 | a <sub>p</sub> : 1D  |                    |                                 | a <sub>p</sub> : 1D   |                    |                                 |

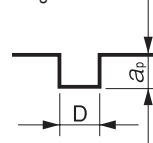
#### Note:

- Decrease both spindle speed and feed rate proportionally in case of chattering.
- These milling parameters are calculated based on the shortest overhang length. Longer overhangs may require an adjustment to the milling parameters.
- Reduce the milling amount and feed rate in accordance with required milling precision.
- Every coolant offers stable milling.
- Recommend water soluble or oil coolant for Stainless Steels.

Side Milling



Slotting



D : Outside Diameter (mm)

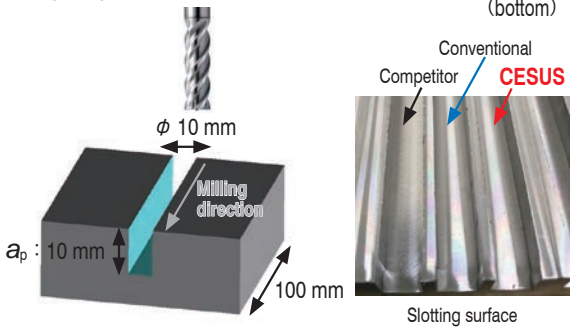
## Milling Example for Slotting Cesus $\phi 10 \times L22$

SUS304

|                  |                         |
|------------------|-------------------------|
| Tool             | CESUS 4100-2200         |
| Spindle Speed    | 3,200 min <sup>-1</sup> |
| Feed Rate        | 900 mm/min*             |
| $a_p$            | 10 mm                   |
| Coolant          | Water Soluble           |
| Milling Distance | 100 mm                  |

\*Milled by higher efficiency conditions than catalogue conditions to evaluate the tool performance.

Milling image



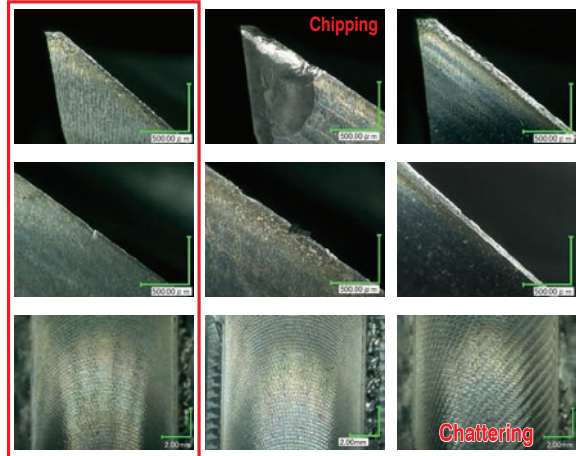
Peripheral (tip)

Peripheral (around  $a_p$ )

CESUS

Conventional

Competitor



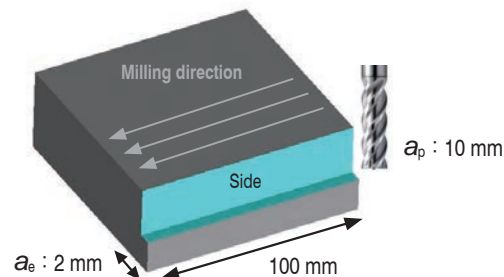
**CESUS offers stable milling with less chattering under highly efficient conditions.**

## Milling Example for Side Milling Cesus $\phi 10 \times L22$

SUS304

|                  |                         |
|------------------|-------------------------|
| Tool             | CESUS 4100-2200         |
| Spindle Speed    | 2,560 min <sup>-1</sup> |
| Feed Rate        | 580 mm/min              |
| $a_p$            | 10 mm                   |
| $a_e$            | 2 mm                    |
| Coolant          | Water Soluble           |
| Milling Distance | 64.8 m                  |
| Cycle Time       | 120 min                 |

Milling image



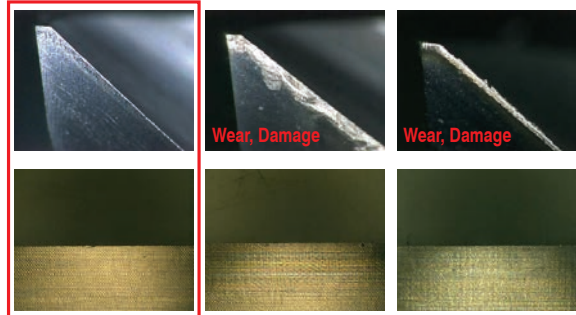
Peripheral (tip)

Milling surface (side)

CESUS

Conventional

Competitor



**CESUS offers longer tool life with less wear and damage after 120 min of milling! Great surface finish without chattering!**

4 Flutes

$\phi 3$ mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



Size  $\phi 3 \sim \phi 12$

# CRN-ES4000

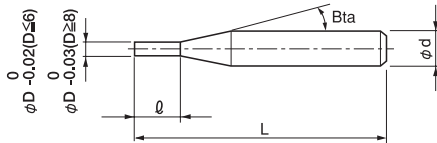


Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           |                 | ○        | ★      | ○        |                       |                 |                       |                  |                                       |

## Features

CrN COAT offers longer tool life.  
 Special geometry designed for Copper offers excellent milling performance.  
 Refer to page 186 for 2 flute CRN-ES.  
 Diameter Tolerance:  $0/-0.02(D \leq 6)$ ,  $0/-0.03(D \geq 8)$



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 10 models

Unit (mm)

| Model Number     | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|------------------|---------------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| CRN-ES 4030-0900 | 3                         | 9                    | 11°                   | 50               | 6                       | 4,620                    |
| CRN-ES 4030-1200 |                           | 12                   | 11°                   | 55               | 6                       | 6,820                    |
| CRN-ES 4040-1200 | 4                         | 12                   | 11°                   | 50               | 6                       | 4,950                    |
| CRN-ES 4040-1600 |                           | 16                   | 11°                   | 55               | 6                       | 7,150                    |
| CRN-ES 4050-1500 | 5                         | 15                   | 11°                   | 55               | 6                       | 5,060                    |
| CRN-ES 4060-1800 | 6                         | 18                   | —                     | 60               | 6                       | 5,390                    |
| CRN-ES 4060-2400 |                           | 24                   | —                     | 65               | 6                       | 8,250                    |
| CRN-ES 4080-2400 | 8                         | 24                   | —                     | 80               | 8                       | 9,480                    |
| CRN-ES 4100-3000 | 10                        | 30                   | —                     | 100              | 10                      | 12,720                   |
| CRN-ES 4120-3600 | 12                        | 36                   | —                     | 100              | 12                      | 15,840                   |

## Milling Conditions for CRN-ES (4 Flutes)

### Side Milling

#### ◆3D flute length type

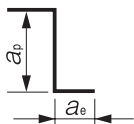
| WORK MATERIAL |                       | COPPER C1100                       |                    |                                 |                                  |
|---------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4030-0900     | 3                     | 10,000                             | 600                | 4.5                             | 0.3                              |
| 4040-1200     | 4                     | 8,000                              | 650                | 6                               | 0.4                              |
| 4050-1500     | 5                     | 6,500                              | 750                | 7.5                             | 0.5                              |
| 4060-1800     | 6                     | 5,500                              | 750                | 9                               | 0.6                              |
| 4080-2400     | 8                     | 4,200                              | 700                | 12                              | 0.8                              |
| 4100-3000     | 10                    | 3,500                              | 700                | 15                              | 1                                |
| 4120-3600     | 12                    | 2,800                              | 700                | 18                              | 1.2                              |

#### ◆4D flute length type

| WORK MATERIAL |                       | COPPER C1100                       |                    |                                 |                                  |
|---------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4030-1200     | 3                     | 5,000                              | 300                | 7.5                             | 0.15                             |
| 4040-1600     | 4                     | 4,000                              | 325                | 10                              | 0.2                              |
| 4060-2400     | 6                     | 3,500                              | 400                | 15                              | 0.3                              |

| Length of Cut |  | 3D Flute Length Type                       | 4D Flute Length Type                        |
|---------------|--|--|---|
| Milling       |  |  |   |
| Side Milling  |  | a <sub>p</sub> 1.5D<br>a <sub>e</sub> 0.1D | a <sub>p</sub> 2.5D<br>a <sub>e</sub> 0.05D |

### Side Milling



D : Outside Diameter (mm)

#### Note:

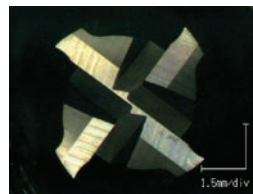
- Decrease both spindle speed and feed rate proportionally in case of chattering.
- Adjust the milling amount and feed rate in accordance with required precision.
- Recommend water soluble or oil coolant.
- Recommended for Pure Copper. Not suitable for Tungsten Copper.

## Milling Example $\phi 6$

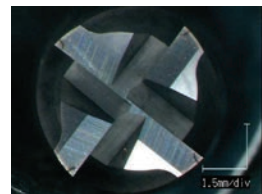
## Pure Copper C1100



### CRN-ES $\phi 6 \times L24$

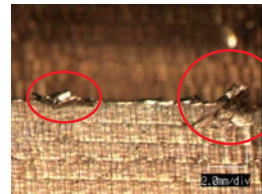
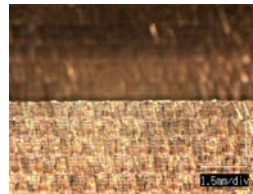


### 4 flute Square for Steels $\phi 6 \times L24$

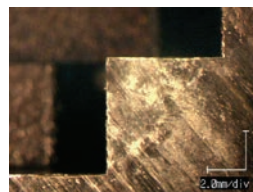


|                |                                  |
|----------------|----------------------------------|
| Milling Method | Z-level slotting<br>Side milling |
| Spindle Speed  | 3,500 min <sup>-1</sup>          |
| Feed Rate      | 2,500 mm/min                     |
| a <sub>p</sub> | 0.6 mm                           |
| a <sub>e</sub> | 4.2 mm                           |
| Coolant        | Water Soluble                    |

Upper surface



Outlet end



CRN-ES has a edge shape dedicated to copper processing that emphasizes sharpness compared to steel. More effective in suppressing burrs than for steel!



Size  $\phi 3 \sim \phi 10$

# DCES4000



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

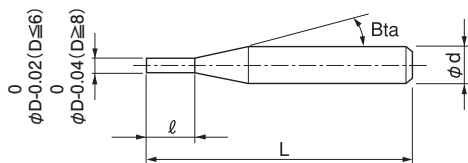
| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           | ○               | ★        | ○      | ○        | ●                     |                 |                       |                  | ○                                     |

## Features

Diamond coated 4 flute square end mills for Graphite Electrodes.

New diamond coating with a highly adhesive base layer offers excellent wear resistance and longer tool life.

Refer to page 188 for 2 flute DCES.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 11 models

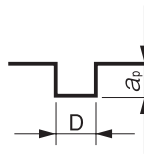
Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Length of Cut $l$ | Shank Taper Angle $Bta$ | Overall Length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|---------------------------|-------------------|-------------------------|--------------------|-------------------------|--------------------------|
| DCES 4030-0900  | 3                         | 9                 | 16°                     | 50                 | 6                       | 20,000                   |
| DCES 4030-1200  |                           | 12                |                         | 50                 | 6                       | 26,000                   |
| DCES 4040-1200  | 4                         | 12                | 16°                     | 50                 | 6                       | 21,000                   |
| DCES 4040-1600  |                           | 16                |                         | 60                 | 6                       | 27,000                   |
| DCES 4060-1800  | 6                         | 18                | —                       | 60                 | 6                       | 22,000                   |
| DCES 4060-1800L |                           | 18                |                         | 100                | 6                       | 30,000                   |
| DCES 4060-2400  |                           | 24                |                         | 60                 | 6                       | 28,000                   |
| DCES 4080-2400  | 8                         | 24                | —                       | 80                 | 8                       | 35,000                   |
| DCES 4080-3200  |                           | 32                |                         | 80                 | 8                       | 41,000                   |
| DCES 4100-3000  | 10                        | 30                | —                       | 90                 | 10                      | 48,000                   |
| DCES 4100-4000  |                           | 40                |                         | 90                 | 10                      | 54,000                   |

## Milling Conditions for DCES (4 Flutes)

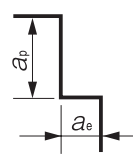
| WORK MATERIAL |                       | GRAPHITE                           |                    |                                 |                                  |                                 |
|---------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|---------------------------------|
| Model Number  | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Side Milling                    |                                  | Slotting                        |
|               |                       |                                    |                    | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | a <sub>p</sub> Axial Depth (mm) |
| 4030          | 3                     | 25,000                             | 3,000              | 6                               | 0.15                             | 0.75                            |
| 4040          | 4                     | 19,000                             | 2,350              | 9                               | 0.2                              | 1                               |
| 4060          | 6                     | 13,000                             | 1,800              | 12                              | 0.48                             | 1.5                             |
| 4080          | 8                     | 9,500                              | 1,400              | 16                              | 0.64                             | 2                               |
| 4100          | 10                    | 7,500                              | 1,200              | 20                              | 0.8                              | 2.5                             |

Slotting



D : Outside Diameter (mm)

Side Milling



**Note:**

- Use a milling machine dedicated for Graphite.
- Recommend air blow for Graphite.

### Other series for Graphite milling

#### Square / Long Neck Square

(★ Highly Recommended ● Recommended ○ Suggested)

| Number of Flutes, Tool Type | Model Number | Appearance | Coating  | Size    | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Hard Brittle (Non-Metallic) Materials | Page |
|-----------------------------|--------------|------------|----------|---------|-----------------|----------|--------|----------|-----------------------|---------------------------------------|------|
|                             |              |            |          |         | ○               | ★        | ○      | ○        | ○                     | ●                                     |      |
| 4 flutes Square             | CGE          |            | Non-coat | φ2~φ20  | ○               | ★        | ○      | ○        | ○                     |                                       | 236  |
| 2 flutes Square             | DCES 2000    |            | DIA      | φ0.2~φ6 | ○               | ★        | ○      | ○        | ●                     | ○                                     | 188  |
| 4 flutes Square             | DCES 4000    |            | DIA      | φ3~φ10  | ○               | ★        | ○      | ○        | ●                     | ○                                     | 234  |
| 2 flutes Long Neck Square   | DCLS         |            | DIA      | φ0.4~φ6 | ○               | ★        | ○      | ○        | ●                     | ○                                     | 266  |

#### Long Neck Radius

|                           |       |  |     |       |   |   |   |   |   |   |     |
|---------------------------|-------|--|-----|-------|---|---|---|---|---|---|-----|
| 4 flutes Long Neck Radius | DCLRS |  | DIA | φ1~φ6 | ○ | ★ | ○ | ○ | ● | ○ | 396 |
|---------------------------|-------|--|-----|-------|---|---|---|---|---|---|-----|

#### Ball / Long Neck Ball / Taper Neck Ball

|                          |          |  |          |         |   |   |   |   |   |   |     |
|--------------------------|----------|--|----------|---------|---|---|---|---|---|---|-----|
| 2 flutes Ball            | CGB 2000 |  | Non-coat | R0.2~R6 | ○ | ★ | ○ | ○ | ○ |   | 440 |
| 4 flutes Ball            | CGB 4000 |  | Non-coat | R2~R10  | ○ | ★ | ○ | ○ | ○ |   | 458 |
| 2 flutes Ball            | DCB      |  | DIA      | R0.5~R6 | ○ | ★ | ○ | ○ | ● | ○ | 438 |
| 2 flutes Long Neck Ball  | DCLB     |  | DIA      | R0.2~R3 | ○ | ★ | ○ | ○ | ● | ○ | 512 |
| 2 flutes Taper Neck Ball | DCTNB    |  | DIA      | R0.5~R1 | ○ | ★ | ○ | ○ | ● | ○ | 556 |

4 Flutes

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



# 4 Flutes NON-COAT for Graphite Milling



Size  $\phi 2 \sim \phi 20$

# CGE

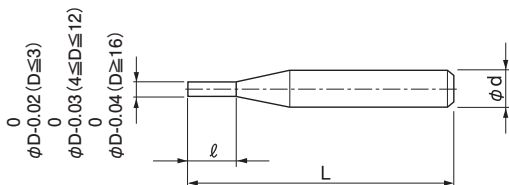


Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           | ○               | ★        | ○      | ○        | ○                     |                 |                       |                  |                                       |

## Features

**Designed for Graphite.**  
**Specific carbide grade offers wear and abrasion resistance.**  
**High helix angle reduces chipping of the work material.**



Total 10 models

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Length of Cut $l$ | Overall Length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|---------------------------|-------------------|--------------------|-------------------------|--------------------------|
| <b>CGE 4020</b> | 2                         | 15                | 60                 | 3                       | 16,800                   |
| <b>CGE 4030</b> | 3                         | 30                | 80                 | 3                       | 16,800                   |
| <b>CGE 4040</b> | 4                         | 30                | 90                 | 4                       | 17,700                   |
| <b>CGE 4050</b> | 5                         | 35                | 100                | 6                       | 18,900                   |
| <b>CGE 4060</b> | 6                         | 40                | 150                | 6                       | 19,320                   |
| <b>CGE 4080</b> | 8                         | 40                | 150                | 8                       | 24,200                   |
| <b>CGE 4100</b> | 10                        | 45                | 180                | 10                      | 30,580                   |
| <b>CGE 4120</b> | 12                        | 55                | 200                | 12                      | 36,850                   |
| <b>CGE 4160</b> | 16                        | 70                | 200                | 16                      | 56,430                   |
| <b>CGE 4200</b> | 20                        | 70                | 200                | 20                      | 87,230                   |



## Milling Conditions for CGE

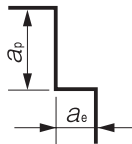
| WORK MATERIAL |                       | GRAPHITE                           |                    |                        |                         |
|---------------|-----------------------|------------------------------------|--------------------|------------------------|-------------------------|
|               |                       | Side Milling                       |                    |                        |                         |
| Model Number  | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 4020          | 2                     | 15,900                             | 300                | 1                      | 0.1                     |
| 4030          | 3                     | 15,900                             | 500                | 1.5                    | 0.15                    |
| 4040          | 4                     | 15,900                             | 650                | 2                      | 0.2                     |
| 4050          | 5                     | 12,700                             | 750                | 2.5                    | 0.25                    |
| 4060          | 6                     | 10,600                             | 850                | 3                      | 0.3                     |
| 4080          | 8                     | 8,000                              | 950                | 4                      | 0.4                     |
| 4100          | 10                    | 6,400                              | 1,000              | 5                      | 0.5                     |
| 4120          | 12                    | 5,310                              | 1,000              | 6                      | 0.6                     |
| 4160          | 16                    | 3,980                              | 1,000              | 8                      | 0.8                     |
| 4200          | 20                    | 3,180                              | 1,000              | 10                     | 1                       |

Milling Amount for side milling (mm)

$$a_p = 0.5D$$

$$a_e = 0.05D$$

D : Outside Diameter (mm)



Note:

- Use a milling machine dedicated for Graphite.
- Recommend air blow for Graphite.

### Other series for Graphite milling

#### Square / Long Neck Square

(★ Highly Recommended ● Recommended ○ Suggested)

| Number of Flutes, Tool Type | Model Number | Appearance | Coating  | Size                   | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Hard Brittle (Non-Metallic) Materials | Page |
|-----------------------------|--------------|------------|----------|------------------------|-----------------|----------|--------|----------|-----------------------|---------------------------------------|------|
|                             |              |            |          |                        | ○               | ★        | ○      | ○        | ○                     | ●                                     |      |
| 4 flutes Square             | CGE          |            | Non-coat | $\phi 2 \sim \phi 20$  | ○               | ★        | ○      | ○        | ○                     |                                       | 236  |
| 2 flutes Square             | DCES 2000    |            | DIA      | $\phi 0.2 \sim \phi 6$ | ○               | ★        | ○      | ○        | ●                     | ○                                     | 188  |
| 4 flutes Square             | DCES 4000    |            | DIA      | $\phi 3 \sim \phi 10$  | ○               | ★        | ○      | ○        | ●                     | ○                                     | 234  |
| 2 flutes Long Neck Square   | DCLS         |            | DIA      | $\phi 0.4 \sim \phi 6$ | ○               | ★        | ○      | ○        | ●                     | ○                                     | 266  |

#### Long Neck Radius

|                           |       |  |     |                      |   |   |   |   |   |   |     |
|---------------------------|-------|--|-----|----------------------|---|---|---|---|---|---|-----|
| 4 flutes Long Neck Radius | DCLRS |  | DIA | $\phi 1 \sim \phi 6$ | ○ | ★ | ○ | ○ | ● | ○ | 396 |
|---------------------------|-------|--|-----|----------------------|---|---|---|---|---|---|-----|

#### Ball / Long Neck Ball / Taper Neck Ball

|                          |          |  |          |         |   |   |   |   |   |   |     |
|--------------------------|----------|--|----------|---------|---|---|---|---|---|---|-----|
| 2 flutes Ball            | CGB 2000 |  | Non-coat | R0.2~R6 | ○ | ★ | ○ | ○ | ○ |   | 440 |
| 4 flutes Ball            | CGB 4000 |  | Non-coat | R2~R10  | ○ | ★ | ○ | ○ | ○ |   | 458 |
| 2 flutes Ball            | DCB      |  | DIA      | R0.5~R6 | ○ | ★ | ○ | ○ | ● | ○ | 438 |
| 2 flutes Long Neck Ball  | DCLB     |  | DIA      | R0.2~R3 | ○ | ★ | ○ | ○ | ● | ○ | 512 |
| 2 flutes Taper Neck Ball | DCTNB    |  | DIA      | R0.5~R1 | ○ | ★ | ○ | ○ | ● | ○ | 556 |

4 Flutes

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 1 \sim \phi 12$

# HMS



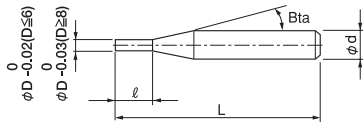
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 | ○                                | ●               | ●      | ●      | ●      |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |

### Features

Offering outstanding tool life by selecting appropriate 3, 4 or 6 flutes on each tool diameter.

Highly efficient milling on hard materials up to 65HRC with HARDMAX COAT.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 27 models

Unit (mm)

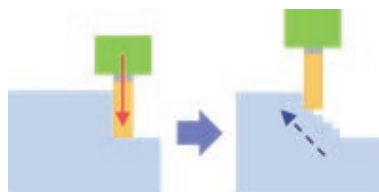
| Model Number  | Outside Diameter $\phi D$ | Length of Cut $\ell$ | Shank Taper Angle $B_{ta}$ | Overall Length $L$ | Shank Diameter $\phi d$ | Number of Flutes | Suggested Retail Price $\text{¥}$ |
|---------------|---------------------------|----------------------|----------------------------|--------------------|-------------------------|------------------|-----------------------------------|
| HMS 3010-0250 | 1                         | 2.5                  | 16°                        | 45                 | 4                       | 3                | 7,500                             |
| HMS 3010-0350 |                           | 3.5                  |                            | 45                 |                         |                  | 10,800                            |
| HMS 3015-0400 |                           | 4                    |                            | 45                 |                         |                  | 7,500                             |
| HMS 3015-0600 | 1.5                       | 6                    | 16°                        | 45                 | 4                       | 3                | 10,800                            |
| HMS 3020-0400 |                           | 4                    |                            | 45                 |                         |                  | 6,700                             |
| HMS 3020-0700 |                           | 7                    |                            | 45                 |                         |                  | 10,000                            |
| HMS 3030-0600 | 3                         | 6                    | 16°                        | 50                 | 6                       | 3                | 9,240                             |
| HMS 3030-1000 |                           | 10                   |                            | 60                 |                         |                  | 9,800                             |
| HMS 3030-1500 |                           | 15                   |                            | 60                 |                         |                  | 10,920                            |
| HMS 4040-0800 | 4                         | 8                    | 16°                        | 50                 | 6                       | 4                | 9,870                             |
| HMS 4040-1200 |                           | 12                   |                            | 60                 |                         |                  | 10,470                            |
| HMS 4040-2000 |                           | 20                   |                            | 70                 |                         |                  | 11,450                            |
| HMS 4050-1000 | 5                         | 10                   | 16°                        | 50                 | 6                       | 4                | 10,500                            |
| HMS 4050-1500 |                           | 15                   |                            | 60                 |                         |                  | 11,100                            |
| HMS 4050-2500 |                           | 25                   |                            | 70                 |                         |                  | 12,180                            |
| HMS 6060-1300 | 6                         | 13                   | —                          | 50                 | 6                       | 6                | 11,340                            |
| HMS 6060-1800 |                           | 18                   |                            | 60                 |                         |                  | 12,100                            |
| HMS 6060-2600 |                           | 26                   |                            | 70                 |                         |                  | 13,230                            |
| HMS 6080-1900 | 8                         | 19                   | —                          | 60                 | 8                       | 6                | 14,630                            |
| HMS 6080-2400 |                           | 24                   |                            | 70                 |                         |                  | 15,000                            |
| HMS 6080-3600 |                           | 36                   |                            | 90                 |                         |                  | 17,160                            |
| HMS 6100-2200 | 10                        | 22                   | —                          | 70                 | 10                      | 6                | 18,360                            |
| HMS 6100-3000 |                           | 30                   |                            | 80                 |                         |                  | 20,000                            |
| HMS 6100-4600 |                           | 46                   |                            | 100                |                         |                  | 22,990                            |
| HMS 6120-2600 | 12                        | 26                   | —                          | 75                 | 12                      | 6                | 24,750                            |
| HMS 6120-3600 |                           | 36                   |                            | 100                |                         |                  | 25,400                            |
| HMS 6120-5600 |                           | 56                   |                            | 120                |                         |                  | 28,600                            |

## Chip color : Selection example of optimal milling conditions from the viewpoint of cutting heat

SKH51 (63HRC)



- Work size : 50 × 50 × 30 mm
- Coolant : Air blow (Through spindle)



Climb up milling by Square end mills

### What is climb up milling?

A milling method that makes effective use of the length of cut to make a large Z-cut in the first shot, and then runs up step by step.

### 1. Check the chip color under 6 types of conditions

|             | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Feed per tooth (mm/t) | Chip color | Result | Efficiency (mm <sup>3</sup> /min) |
|-------------|------------------------------------|--------------------|------------|------------|-----------------------|------------|--------|-----------------------------------|
| Condition 1 | 4,000                              | 1,350              | 10         | 0.15       | 0.056                 | Dark Blue  | ×      | 2,025                             |
| Condition 2 | 3,000                              | 1,000              | 10         | 0.15       | 0.056                 | Red Gold   | ✓      | 1,500                             |
| Condition 3 | 2,000                              | 675                | 10         | 0.15       | 0.056                 | Gold       | ✓      | 1,013                             |
| Condition 4 | 2,000                              | 675                | 20         | 0.2        | 0.056                 | Red Gold   | ✓      | 2,700                             |
| Condition 5 | 2,000                              | 1,000              | 20         | 0.2        | 0.083                 | Red Gold   | ✓      | 4,000                             |
| Condition 6 | 2,000                              | 1,000              | 20         | 0.4        | 0.083                 | Dark Blue  | ×      | 8,000                             |

### 2. Relationship between chip color and cutting heat



### 3. Optimal cutting condition

Condition 5 is judged to be the optimum condition based on the chip color and processing efficiency. No damage due to chipping of tools after 1 hour roughing process.

Tool after 1 hour roughing process



3 Flutes

4 Flutes

6 Flutes

Ø3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Radius

Radius

Long Neck Radius

Radius

Taper Neck Radius

Ball

Ball / Long Shank Ball

Ball

Long Neck Ball

Ball

Taper Neck Ball

Taper

Taper

Barrel

Barrel

Spiral

Spiral V Cutter

Drill

Drill

Technical Data

Technical Data

## Milling Conditions for HMS

### ◆Short length of cut

| WORK MATERIAL       |                  |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>(40~50HRC)  |                    |            |            |              | HARDENED STEELS<br>(50~60HRC) |                                    |                    |            |            | HARDENED STEELS<br>(60HRC~) |            |                                    |                    |            |            |              |            |     |       |
|---------------------|------------------|-----------------------|--|--------------------|------------|------------|--------------|-------------------------------|------------------------------------|--------------------|------------|------------|-----------------------------|------------|------------------------------------|--------------------|------------|------------|--------------|------------|-----|-------|
| Model Number        | Number of Flutes | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | Slotting   |            | Side Milling |                               | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Slotting   |            | Side Milling                |            | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Slotting   |            | Side Milling |            |     |       |
|                     |                  |                       |  |                    | $a_p$ (mm) | $a_e$ (mm) | $a_p$ (mm)   | $a_e$ (mm)                    |                                    |                    | $a_p$ (mm) | $a_e$ (mm) | $a_p$ (mm)                  | $a_e$ (mm) |                                    |                    | $a_p$ (mm) | $a_e$ (mm) | $a_p$ (mm)   | $a_e$ (mm) |     |       |
| 3010-0250           | 3                | 1                     | 9,500  | 140                | 0.05       | 1          | 0.05         | 6,400                         | 95                                 | 0.05               | 1          | 0.05       | 6,400                       | 90         | 0.05                               | 1                  | 0.05       | 6,400      | 90           | 0.05       | 1   | 0.05  |
| 3015-0400           |                  | 1.5                   | 6,400  | 100                | 0.075      | 1.5        | 0.075        | 4,200                         | 60                                 | 0.075              | 1.5        | 0.075      | 4,200                       | 60         | 0.075                              | 1.5                | 0.075      | 4,200      | 60           | 0.075      | 1.5 | 0.075 |
| 3020-0400           |                  | 2                     | 4,700  | 80                 | 0.1        | 2          | 0.1          | 3,200                         | 75                                 | 0.1                | 2          | 0.1        | 3,200                       | 70         | 0.1                                | 2                  | 0.1        | 3,200      | 70           | 0.1        | 2   | 0.1   |
| 3030-0600           |                  | 3                     | 3,200  | 85                 | 0.15       | 3          | 0.15         | 2,100                         | 80                                 | 0.15               | 3          | 0.15       | 2,100                       | 80         | 0.15                               | 3                  | 0.15       | 2,100      | 80           | 0.15       | 3   | 0.15  |
| 4040-0800           | 4                | 4                     | 2,400  | 90                 | 0.2        | 4          | 0.2          | 1,600                         | 85                                 | 0.2                | 4          | 0.2        | 1,600                       | 80         | 0.2                                | 4                  | 0.2        | 1,600      | 80           | 0.2        | 4   | 0.2   |
| 4050-1000           |                  | 5                     | 1,900  | 90                 | 0.25       | 5          | 0.25         | 1,300                         | 85                                 | 0.25               | 5          | 0.25       | 1,300                       | 80         | 0.25                               | 5                  | 0.25       | 1,300      | 80           | 0.25       | 5   | 0.25  |
| 6060-1300           | 6                | 6                     | 1,600  | 170                | 0.3        | 6          | 0.3          | 1,100                         | 120                                | 0.3                | 6          | 0.3        | 1,100                       | 110        | 0.3                                | 6                  | 0.3        | 1,100      | 110          | 0.3        | 6   | 0.3   |
| 6080-1900           |                  | 8                     | 1,200  | 170                | 0.4        | 8          | 0.4          | 800                           | 120                                | 0.4                | 8          | 0.4        | 800                         | 110        | 0.4                                | 8                  | 0.4        | 800        | 110          | 0.4        | 8   | 0.4   |
| 6100-2200           |                  | 10                    | 950  | 170                | 0.5        | 15         | 0.5          | 640                           | 100                                | 0.5                | 15         | 0.5        | 640                         | 80         | 0.5                                | 15                 | 0.5        | 640        | 80           | 0.5        | 15  | 0.5   |
| 6120-2600           |                  | 12                    | 800  | 170                | 0.5        | 18         | 0.5          | 530                           | 90                                 | 0.5                | 18         | 0.5        | 530                         | 70         | 0.5                                | 18                 | 0.5        | 530        | 70           | 0.5        | 18  | 0.5   |
| Milling Amount (mm) |                  | Slotting              | $a_p \leq 0.05D$ (max 0.5 mm)  |                    |            |            |              |                               |                                    |                    |            |            |                             |            |                                    |                    |            |            |              |            |     |       |
|                     |                  | Side Milling          | $D \leq \phi 8 \quad a_p = 1D$<br>$D \geq \phi 10 \quad a_p = 1.5D$<br>$a_e \leq 0.05D$ (max 0.5 mm) |                    |            |            |              |                               |                                    |                    |            |            |                             |            |                                    |                    |            |            |              |            |     |       |

### ◆High speed milling for short length of cut

| WORK MATERIAL       |                  |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>(40~50HRC) |                    |              |            |                                    | HARDENED STEELS<br>(50~60HRC)  |              |            |                                    |                    | HARDENED STEELS<br>(60HRC~)  |            |  |  |  |
|---------------------|------------------|-----------------------|---|--------------------|--------------|------------|------------------------------------|--------------------------------|--------------|------------|------------------------------------|--------------------|--|------------|--|--|--|
| Model Number        | Number of Flutes | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | Side Milling |            | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)             | Side Milling |            | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Side Milling   |            |  |  |  |
|                     |                  |                       |   |                    | $a_p$ (mm)   | $a_e$ (mm) |                                    |                                | $a_p$ (mm)   | $a_e$ (mm) |                                    |                    | $a_p$ (mm)   | $a_e$ (mm) |  |  |  |
| 3010-0250           | 3                | 1                     | 22,500  | 630                | 1.5          | 0.03       | 20,000                             | 540                            | 1.5          | 0.02       | 15,000                             | 450                | 0.5  | 0.01       |  |  |  |
| 3015-0400           |                  | 1.5                   | 18,000  | 720                | 2.25         | 0.045      | 16,000                             | 630                            | 2.25         | 0.03       | 11,500                             | 540                | 0.75   | 0.015      |  |  |  |
| 3020-0400           |                  | 2                     | 14,300  | 850                | 3            | 0.06       | 13,000                             | 750                            | 3            | 0.04       | 8,500                              | 630                | 1  | 0.02       |  |  |  |
| 3030-0600           |                  | 3                     | 13,100  | 1,120              | 4.5          | 0.09       | 11,200                             | 950                            | 4.5          | 0.06       | 6,700                              | 760                | 1.5  | 0.03       |  |  |  |
| 4040-0800           | 4                | 4                     | 11,300  | 1,300              | 6            | 0.12       | 9,900                              | 1,170                          | 6            | 0.08       | 2,850                              | 630                | 8  | 0.08       |  |  |  |
| 4050-1000           |                  | 5                     | 10,100  | 1,530              | 7.5          | 0.15       | 8,900                              | 1,350                          | 7.5          | 0.1        | 2,400                              | 700                | 10   | 0.1        |  |  |  |
| 6060-1300           | 6                | 6                     | 8,900   | 1,950              | 9            | 0.18       | 8,000                              | 1,800                          | 9            | 0.12       | 2,150                              | 830                | 12   | 0.12       |  |  |  |
| 6080-1900           |                  | 8                     | 7,700   | 2,350              | 12           | 0.24       | 6,900                              | 2,200                          | 12           | 0.16       | 2,100                              | 900                | 16   | 0.16       |  |  |  |
| 6100-2200           |                  | 10                    | 6,700   | 3,100              | 15           | 0.3        | 6,000                              | 2,700                          | 15           | 0.2        | 2,000                              | 1,000              | 20   | 0.2        |  |  |  |
| 6120-2600           |                  | 12                    | 5,800   | 3,000              | 18           | 0.36       | 5,300                              | 2,500                          | 18           | 0.24       | 1,950                              | 1,070              | 24   | 0.24       |  |  |  |
| Milling Amount (mm) |                  | Side Milling          | $a_p = 1.5D$<br>$a_e = 0.03D$ (max 0.5 mm)          |                    |              |            |                                    | $a_p = 1.5D \quad a_e = 0.02D$ |              |            |                                    |                    | $D \leq \phi 3 \quad a_p = 0.5D$<br>$a_e = 0.01D$<br>$D \geq \phi 4 \quad a_p = 2D$<br>$a_e = 0.02D$ |            |  |  |  |

# Milling Conditions for HMS

## ◆Medium length of cut

| WORK MATERIAL       |                  |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>(40~50HRC)  |                    |                     |                     |                     | HARDENED STEELS<br>(50~60HRC) |                                    |                    |                     |                     | HARDENED STEELS<br>(60HRC~) |                     |                                    |                    |                     |                     |              |  |
|---------------------|------------------|-----------------------|--|--------------------|---------------------|---------------------|---------------------|-------------------------------|------------------------------------|--------------------|---------------------|---------------------|-----------------------------|---------------------|------------------------------------|--------------------|---------------------|---------------------|--------------|--|
| Model Number        | Number of Flutes | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | Slotting            |                     | Side Milling        |                               | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Slotting            |                     | Side Milling                |                     | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Slotting            |                     | Side Milling |  |
|                     |                  |                       |  |                    | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm)           |                                    |                    | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | a <sub>p</sub> (mm)         | a <sub>e</sub> (mm) |                                    |                    | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |              |  |
| 3030-1000           | 3                | 3                     | 3,200  | 43~85              | 0.09                | 6                   | 0.09                | 2,100                         | 40~80                              | 0.09               | 6                   | 0.09                | 2,100                       | 40~80               | 0.09                               | 6                  | 0.09                | 6                   | 0.09         |  |
| 4040-1200           | 4                | 4                     | 2,400  | 45~90              | 0.12                | 8                   | 0.12                | 1,600                         | 43~85                              | 0.12               | 8                   | 0.12                | 1,600                       | 40~80               | 0.12                               | 8                  | 0.12                | 8                   | 0.12         |  |
| 4050-1500           |                  | 5                     | 1,900  | 45~90              | 0.15                | 10                  | 0.15                | 1,300                         | 43~85                              | 0.15               | 10                  | 0.15                | 1,300                       | 40~80               | 0.15                               | 10                 | 0.15                | 10                  | 0.15         |  |
| 6060-1800           | 6                | 6                     | 1,600  | 85~170             | 0.18                | 12                  | 0.18                | 1,100                         | 60~120                             | 0.18               | 12                  | 0.18                | 1,100                       | 55~110              | 0.18                               | 12                 | 0.18                | 12                  | 0.18         |  |
| 6080-2400           |                  | 8                     | 1,200  | 85~170             | 0.24                | 16                  | 0.24                | 800                           | 60~120                             | 0.24               | 16                  | 0.24                | 800                         | 55~110              | 0.24                               | 16                 | 0.24                | 16                  | 0.24         |  |
| 6100-3000           |                  | 10                    | 950  | 85~170             | 0.3                 | 25                  | 0.3                 | 640                           | 50~100                             | 0.3                | 25                  | 0.3                 | 640                         | 40~80               | 0.3                                | 25                 | 0.3                 | 25                  | 0.3          |  |
| 6120-3600           |                  | 12                    | 800  | 85~170             | 0.3                 | 30                  | 0.3                 | 530                           | 45~90                              | 0.3                | 30                  | 0.3                 | 530                         | 35~70               | 0.3                                | 30                 | 0.3                 | 30                  | 0.3          |  |
| Milling Amount (mm) |                  | Slotting              | $a_p \leq 0.03D$ (max 0.3 mm)  |                    |                     |                     |                     |                               |                                    |                    |                     |                     |                             |                     |                                    |                    |                     |                     |              |  |
|                     |                  | Side Milling          | $D \leq \phi 8 \quad a_p = 2D$<br>$D \geq \phi 10 \quad a_p = 2.5D$<br>$a_e \leq 0.03D$ (max 0.3 mm) |                    |                     |                     |                     |                               |                                    |                    |                     |                     |                             |                     |                                    |                    |                     |                     |              |  |

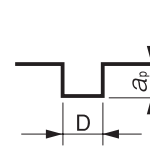
## ◆Long length of cut

| WORK MATERIAL       |                  |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>(40~50HRC) |                    |                     |                     | HARDENED STEELS<br>(50~60HRC)      |                    |                     |                     | HARDENED STEELS<br>(60HRC~)        |                    |                     |                     |
|---------------------|------------------|-----------------------|---|--------------------|---------------------|---------------------|------------------------------------|--------------------|---------------------|---------------------|------------------------------------|--------------------|---------------------|---------------------|
| Model Number        | Number of Flutes | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | Side Milling        |                     | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Side Milling        |                     | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Side Milling        |                     |
|                     |                  |                       |   |                    | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |                                    |                    | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |                                    |                    | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |
| 3010-0350           | 3                | 1                     | 9,500   | 140~210            | 3                   | 0.02                | 6,400                              | 95~143             | 3                   | 0.02                | 6,400                              | 95~133             | 3                   | 0.02                |
| 3015-0600           |                  | 1.5                   | 6,300   | 100~150            | 4.5                 | 0.03                | 4,200                              | 80~120             | 4.5                 | 0.03                | 4,200                              | 80~112             | 4.5                 | 0.03                |
| 3020-0700           |                  | 2                     | 4,700   | 80~120             | 6                   | 0.04                | 3,200                              | 75~113             | 6                   | 0.04                | 3,200                              | 75~113             | 6                   | 0.04                |
| 3030-1500           |                  | 3                     | 3,200   | 85~128             | 9                   | 0.06                | 2,100                              | 80~120             | 9                   | 0.06                | 2,100                              | 80~120             | 9                   | 0.06                |
| 4040-2000           | 4                | 4                     | 2,400   | 90~135             | 12                  | 0.08                | 1,600                              | 85~128             | 12                  | 0.08                | 1,600                              | 83~125             | 12                  | 0.08                |
| 4050-2500           |                  | 5                     | 1,900   | 90~135             | 15                  | 0.1                 | 1,300                              | 85~128             | 15                  | 0.1                 | 1,300                              | 83~125             | 15                  | 0.1                 |
| 6060-2600           | 6                | 6                     | 1,600   | 170~255            | 18                  | 0.12                | 1,100                              | 120~180            | 18                  | 0.12                | 1,100                              | 112~168            | 18                  | 0.12                |
| 6080-3600           |                  | 8                     | 1,200   | 170~255            | 24                  | 0.16                | 800                                | 120~180            | 24                  | 0.16                | 800                                | 110~166            | 24                  | 0.16                |
| 6100-4600           |                  | 10                    | 950   | 170~255            | 30                  | 0.2                 | 640                                | 100~150            | 30                  | 0.2                 | 640                                | 88~132             | 30                  | 0.2                 |
| 6120-5600           |                  | 12                    | 800   | 170~255            | 36                  | 0.24                | 530                                | 90~135             | 36                  | 0.24                | 530                                | 76~114             | 36                  | 0.24                |
| Milling Amount (mm) |                  | Side Milling          | $a_p = 3D$  |                    |                     |                     |                                    |                    |                     |                     |                                    |                    |                     |                     |
|                     |                  |                       | $a_e \leq 0.02D$                                    |                    |                     |                     |                                    |                    |                     |                     |                                    |                    |                     |                     |

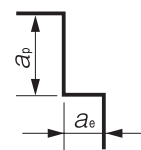
Note:

- Recommend down cut processing.
- Reduce cutting amount, feed rate, and apply zero-cut in accordance with required surface quality.
- Recommend air blow or oil mist.

Slotting



Side Milling



D : Outside Diameter (mm)

3 Flutes

4 Flutes

6 Flutes

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.1 \sim \phi 6$

# HLS2000

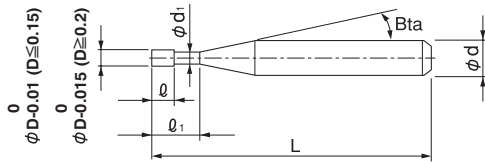


Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

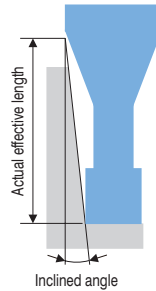
| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●      | ○      |        |        |           |                 |          | ○      |          |                       | ○               | ○                     |                  |                                       |

## Features

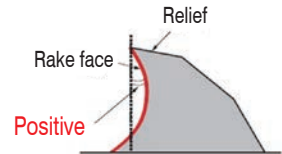
**HARDMAX coating and optimized tool design control tool chipping.**  
**Longer tool life with deep rib milling on hard materials.**  
**High Accuracy: Diameter Tolerance: 0/-0.01 ( $D \leq 0.15$ ), 0/-0.015 ( $D \geq 0.2$ )**  
**Refer to page 288 for 4 flute HLS.**



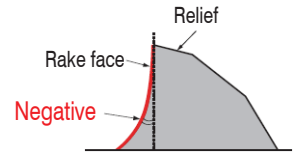
The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



### C-CER Cutting edge



### HLS Cutting edge



Total 189 models

Unit (mm)

| Model Number   | Outside Diameter $\phi D$ | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $Bta$ | Overall Length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price $\text{¥}$ | Effective Length by Inclined Angles |      |        |      |      |
|----------------|---------------------------|------------------------|-------------------|--------------------------|-------------------------|--------------------|-------------------------|-----------------------------------|-------------------------------------|------|--------|------|------|
|                |                           |                        |                   |                          |                         |                    |                         |                                   | 30'                                 | 1°   | 1° 30' | 2°   | 3°   |
| HLS 2001-003   | 0.1                       | 0.3                    | 0.1               | 0.088                    | 11°                     | 45                 | 4                       | 11,160                            | 0.33                                | 0.36 | 0.38   | 0.40 | 0.45 |
| HLS 2001-005   |                           | 0.5                    |                   |                          |                         | 45                 | 4                       | 12,240                            | 0.54                                | 0.58 | 0.61   | 0.64 | 0.69 |
| HLS 2001-0075  |                           | 0.75                   |                   |                          |                         | 45                 | 4                       | 13,560                            | 0.80                                | 0.85 | 0.90   | 0.95 | 1.07 |
| HLS 2001-010   | 0.15                      | 1                      | 0.15              | 0.128                    | 11°                     | 45                 | 4                       | 15,240                            | 1.07                                | 1.12 | 1.18   | 1.25 | 1.41 |
| HLS 20015-005  |                           | 0.5                    |                   |                          |                         | 45                 | 4                       | 11,400                            | 0.58                                | 0.61 | 0.63   | 0.66 | 0.71 |
| HLS 20015-0075 |                           | 0.75                   |                   |                          |                         | 45                 | 4                       | 12,600                            | 0.84                                | 0.88 | 0.91   | 0.94 | 1.02 |
| HLS 20015-010  | 0.2                       | 1                      | 0.3               | 0.18                     | 16°                     | 45                 | 4                       | 12,600                            | 1.10                                | 1.14 | 1.18   | 1.23 | 1.32 |
| HLS 2002-005   |                           | 0.5                    |                   |                          |                         | 45                 | 4                       | 7,320                             | 0.65                                | 0.70 | 0.74   | 0.78 | 0.85 |
| HLS 2002-010   |                           | 1                      |                   |                          |                         | 45                 | 4                       | 7,920                             | 1.18                                | 1.25 | 1.31   | 1.36 | 1.45 |
| HLS 2002-015   | 0.2                       | 1.5                    | 0.3               | 0.18                     | 16°                     | 45                 | 4                       | 9,600                             | 1.67                                | 1.76 | 1.84   | 1.90 | 2.01 |
| HLS 2002-020   |                           | 2                      |                   |                          |                         | 45                 | 4                       | 10,800                            | 2.23                                | 2.33 | 2.41   | 2.49 | 2.68 |
| HLS 2002-030   |                           | 3                      |                   |                          |                         | 45                 | 4                       | 11,160                            | 3.27                                | 3.39 | 3.51   | 3.63 | 3.91 |

| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |        |       |       |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|--------|-------|-------|
|              |                           |                           |                      |                          |                       |                  |                         |                          | 30°                                 | 1°    | 1° 30' | 2°    | 3°    |
| HLS 2003-010 | 0.3                       | 1                         | 0.4                  | 0.28                     | 16°                   | 45               | 4                       | 6,480                    | 1.22                                | 1.30  | 1.37   | 1.43  | 1.55  |
| HLS 2003-015 |                           | 1.5                       |                      |                          |                       | 45               | 4                       | 6,480                    | 1.71                                | 1.82  | 1.91   | 1.98  | 2.12  |
| HLS 2003-020 |                           | 2                         |                      |                          |                       | 45               | 4                       | 7,920                    | 2.24                                | 2.36  | 2.46   | 2.55  | 2.70  |
| HLS 2003-025 |                           | 2.5                       |                      |                          |                       | 45               | 4                       | 8,280                    | 2.77                                | 2.91  | 3.02   | 3.11  | 3.27  |
| HLS 2003-030 |                           | 3                         |                      |                          |                       | 45               | 4                       | 8,280                    | 3.30                                | 3.45  | 3.56   | 3.66  | 3.83  |
| HLS 2003-040 |                           | 4                         |                      |                          |                       | 45               | 4                       | 9,480                    | 4.35                                | 4.51  | 4.64   | 4.75  | 4.94  |
| HLS 2003-060 |                           | 6                         |                      |                          |                       | 45               | 4                       | 10,560                   | 6.43                                | 6.63  | 6.78   | 6.91  | 7.12  |
| HLS 2003-090 |                           | 9                         |                      |                          |                       | 45               | 4                       | 11,160                   | 9.53                                | 9.76  | 9.94   | 10.09 | 10.32 |
| HLS 2004-015 |                           | 0.4                       |                      |                          |                       | 1.5              | 0.6                     | 0.38                     | 16°                                 | 45    | 4      | 4,680 | 1.77  |
| HLS 2004-020 | 2                         |                           | 45                   | 4                        | 4,680                 | 2.31             |                         |                          |                                     | 2.47  | 2.60   | 2.71  | 2.91  |
| HLS 2004-025 | 2.5                       |                           | 45                   | 4                        | 4,680                 | 2.85             |                         |                          |                                     | 3.02  | 3.16   | 3.28  | 3.49  |
| HLS 2004-030 | 3                         |                           | 45                   | 4                        | 4,680                 | 3.38             |                         |                          |                                     | 3.57  | 3.72   | 3.85  | 4.07  |
| HLS 2004-035 | 3.5                       |                           | 45                   | 4                        | 4,680                 | 3.91             |                         |                          |                                     | 4.11  | 4.27   | 4.41  | 4.64  |
| HLS 2004-040 | 4                         |                           | 45                   | 4                        | 4,680                 | 4.44             |                         |                          |                                     | 4.65  | 4.82   | 4.96  | 5.21  |
| HLS 2004-050 | 5                         |                           | 45                   | 4                        | 4,680                 | 5.49             |                         |                          |                                     | 5.73  | 5.91   | 6.06  | 6.33  |
| HLS 2004-080 | 8                         |                           | 45                   | 4                        | 10,200                | 8.63             |                         |                          |                                     | 8.91  | 9.13   | 9.31  | 9.62  |
| HLS 2004-120 | 12                        |                           | 45                   | 4                        | 11,160                | 12.77            |                         |                          |                                     | 13.10 | 13.36  | 13.57 | 13.91 |
| HLS 2005-015 | 0.5                       | 1.5                       | 0.7                  | 0.48                     | 16°                   | 45               | 4                       | 3,360                    | 1.83                                | 1.99  | 2.13   | 2.25  | 2.48  |
| HLS 2005-020 |                           | 2                         |                      |                          |                       | 45               | 4                       | 3,360                    | 2.37                                | 2.56  | 2.71   | 2.85  | 3.09  |
| HLS 2005-025 |                           | 2.5                       |                      |                          |                       | 45               | 4                       | 3,360                    | 2.92                                | 3.12  | 3.29   | 3.43  | 3.69  |
| HLS 2005-030 |                           | 3                         |                      |                          |                       | 45               | 4                       | 3,360                    | 3.45                                | 3.68  | 3.85   | 4.01  | 4.28  |
| HLS 2005-040 |                           | 4                         |                      |                          |                       | 45               | 4                       | 3,360                    | 4.52                                | 4.77  | 4.97   | 5.14  | 5.44  |
| HLS 2005-050 |                           | 5                         |                      |                          |                       | 45               | 4                       | 3,360                    | 5.58                                | 5.86  | 6.08   | 6.26  | 6.58  |
| HLS 2005-060 |                           | 6                         |                      |                          |                       | 45               | 4                       | 3,360                    | 6.64                                | 6.94  | 7.17   | 7.37  | 7.71  |
| HLS 2005-080 |                           | 8                         |                      |                          |                       | 45               | 4                       | 5,640                    | 8.74                                | 9.07  | 9.33   | 9.56  | 9.93  |
| HLS 2005-100 |                           | 10                        |                      |                          |                       | 50               | 4                       | 5,640                    | 10.82                               | 11.19 | 11.48  | 11.72 | 12.12 |
| HLS 2005-150 | 15                        | 50                        | 4                    | 7,200                    | 16.00                 | 16.44            | 16.78                   | 17.05                    | 17.50                               |       |        |       |       |
| HLS 2006-020 | 0.6                       | 2                         | 0.9                  | 0.58                     | 16°                   | 45               | 4                       | 3,600                    | 2.39                                | 2.62  | 2.80   | 2.96  | 3.24  |
| HLS 2006-030 |                           | 3                         |                      |                          |                       | 45               | 4                       | 3,600                    | 3.49                                | 3.75  | 3.96   | 4.14  | 4.32  |
| HLS 2006-040 |                           | 4                         |                      |                          |                       | 45               | 4                       | 3,600                    | 4.57                                | 4.86  | 5.09   | 5.29  | 5.69  |
| HLS 2006-050 |                           | 5                         |                      |                          |                       | 45               | 4                       | 3,600                    | 5.64                                | 5.96  | 6.21   | 6.43  | 6.92  |
| HLS 2006-060 |                           | 6                         |                      |                          |                       | 45               | 4                       | 3,600                    | 6.70                                | 7.05  | 7.32   | 7.57  | 8.14  |
| HLS 2006-070 |                           | 7                         |                      |                          |                       | 45               | 4                       | 4,560                    | 7.76                                | 8.13  | 8.42   | 8.71  | 9.36  |
| HLS 2006-080 |                           | 8                         |                      |                          |                       | 45               | 4                       | 5,880                    | 8.81                                | 9.20  | 9.52   | 9.85  | 10.59 |
| HLS 2006-100 |                           | 10                        |                      |                          |                       | 45               | 4                       | 6,720                    | 10.91                               | 11.34 | 11.72  | 12.13 | 13.04 |
| HLS 2006-120 |                           | 12                        |                      |                          |                       | 50               | 4                       | 7,560                    | 13.00                               | 13.47 | 13.92  | 14.40 | 15.48 |
| HLS 2006-180 |                           | 18                        |                      |                          |                       | 50               | 4                       | 9,120                    | 19.23                               | 19.85 | 20.52  | 21.24 | 22.82 |

3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |        |       |                 |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|--------|-------|-----------------|
|              |                           |                           |                      |                          |                       |                  |                         |                          | 30'                                 | 1°    | 1° 30' | 2°    | 3°              |
| HLS 2007-020 | 0.7                       | 2                         | 1                    | 0.68                     | 16°                   | 45               | 4                       | 4,080                    | 2.39                                | 2.62  | 2.80   | 2.96  | 3.24            |
| HLS 2007-040 |                           | 4                         |                      |                          |                       | 45               | 4                       | 4,080                    | 4.57                                | 4.86  | 5.09   | 5.29  | 5.69            |
| HLS 2007-060 |                           | 6                         |                      |                          |                       | 45               | 4                       | 4,080                    | 6.70                                | 7.05  | 7.32   | 7.57  | 8.14            |
| HLS 2007-080 |                           | 8                         |                      |                          |                       | 45               | 4                       | 6,600                    | 8.81                                | 9.20  | 9.52   | 9.85  | 10.59           |
| HLS 2007-100 |                           | 10                        |                      |                          |                       | 50               | 4                       | 7,520                    | 10.91                               | 11.34 | 11.72  | 12.13 | 13.04           |
| HLS 2008-030 | 0.8                       | 3                         | 1.2                  | 0.78                     | 16°                   | 45               | 4                       | 3,960                    | 3.49                                | 3.75  | 3.96   | 4.14  | 4.32            |
| HLS 2008-040 |                           | 4                         |                      |                          |                       | 45               | 4                       | 3,960                    | 4.57                                | 4.86  | 5.09   | 5.29  | 5.69            |
| HLS 2008-050 |                           | 5                         |                      |                          |                       | 45               | 4                       | 3,960                    | 5.64                                | 5.96  | 6.21   | 6.43  | 6.92            |
| HLS 2008-060 |                           | 6                         |                      |                          |                       | 45               | 4                       | 3,960                    | 6.70                                | 7.05  | 7.32   | 7.57  | 8.14            |
| HLS 2008-080 |                           | 8                         |                      |                          |                       | 45               | 4                       | 3,960                    | 8.81                                | 9.20  | 9.52   | 9.85  | 10.59           |
| HLS 2008-100 |                           | 10                        |                      |                          |                       | 50               | 4                       | 5,880                    | 10.91                               | 11.34 | 11.72  | 12.13 | 13.04           |
| HLS 2008-120 |                           | 12                        |                      |                          |                       | 50               | 4                       | 6,600                    | 13.00                               | 13.47 | 13.92  | 14.40 | 15.48           |
| HLS 2008-160 |                           | 16                        |                      |                          |                       | 50               | 4                       | 7,560                    | 17.16                               | 17.73 | 18.32  | 18.96 | 20.38           |
| HLS 2008-240 |                           | 24                        |                      |                          |                       | 60               | 4                       | 9,240                    | 25.42                               | 26.24 | 27.13  | 28.07 | 30.17           |
| HLS 2009-040 |                           | 0.9                       |                      |                          |                       | 4                | 1.3                     | 0.88                     | 16°                                 | 45    | 4      | 4,560 | 4.57            |
| HLS 2009-060 | 6                         |                           | 45                   | 4                        | 4,560                 | 6.70             |                         |                          |                                     | 7.05  | 7.32   | 7.57  | 8.14            |
| HLS 2009-080 | 8                         |                           | 45                   | 4                        | 4,560                 | 8.81             |                         |                          |                                     | 9.20  | 9.52   | 9.85  | 10.59           |
| HLS 2009-100 | 10                        |                           | 45                   | 4                        | 4,560                 | 10.91            |                         |                          |                                     | 11.34 | 11.72  | 12.13 | 13.04           |
| HLS 2009-150 | 15                        |                           | 50                   | 4                        | 6,790                 | 16.12            |                         |                          |                                     | 16.66 | 17.22  | 17.82 | 19.15           |
| HLS 2010-030 | 1                         | 3                         | 1.5                  | 0.95                     | 16°                   | 45               | 4                       | 3,600                    | 3.62                                | 3.85  | 4.04   | 4.21  | 4.54            |
| HLS 2010-040 |                           | 4                         |                      |                          |                       | 45               | 4                       | 3,600                    | 4.69                                | 4.95  | 5.16   | 5.36  | 5.76            |
| HLS 2010-050 |                           | 5                         |                      |                          |                       | 45               | 4                       | 3,600                    | 5.75                                | 6.04  | 6.27   | 6.49  | 6.98            |
| HLS 2010-060 |                           | 6                         |                      |                          |                       | 45               | 4                       | 3,600                    | 6.80                                | 7.12  | 7.38   | 7.63  | 8.21            |
| HLS 2010-070 |                           | 7                         |                      |                          |                       | 45               | 4                       | 3,600                    | 7.85                                | 8.19  | 8.48   | 8.77  | 9.43            |
| HLS 2010-080 |                           | 8                         |                      |                          |                       | 45               | 4                       | 3,600                    | 8.90                                | 9.26  | 9.58   | 9.91  | 10.65           |
| HLS 2010-090 |                           | 9                         |                      |                          |                       | 45               | 4                       | 3,600                    | 9.95                                | 10.33 | 10.68  | 11.05 | 11.88           |
| HLS 2010-100 |                           | 10                        |                      |                          |                       | 45               | 4                       | 3,600                    | 10.99                               | 11.39 | 11.78  | 12.19 | 13.10           |
| HLS 2010-120 |                           | 12                        |                      |                          |                       | 45               | 4                       | 3,600                    | 13.07                               | 13.52 | 13.98  | 14.47 | 15.55           |
| HLS 2010-140 |                           | 14                        |                      |                          |                       | 45               | 4                       | 3,600                    | 15.15                               | 15.65 | 16.18  | 16.74 | 18.00           |
| HLS 2010-160 |                           | 16                        |                      |                          |                       | 50               | 4                       | 5,880                    | 17.22                               | 17.78 | 18.38  | 19.02 | 20.44           |
| HLS 2010-180 |                           | 18                        |                      |                          |                       | 55               | 4                       | 5,880                    | 19.29                               | 19.92 | 20.59  | 21.30 | 22.90           |
| HLS 2010-200 |                           | 20                        |                      |                          |                       | 55               | 4                       | 5,880                    | 21.35                               | 22.04 | 22.78  | 23.57 | 25.34           |
| HLS 2010-250 |                           | 25                        |                      |                          |                       | 70               | 4                       | 6,720                    | 26.51                               | 27.37 | 28.29  | 29.27 | No Interference |
| HLS 2010-300 |                           | 30                        |                      |                          |                       | 70               | 4                       | 7,560                    | 31.66                               | 32.69 | 33.79  | 34.96 | No Interference |

- $\phi 3\text{mm}$  Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |                 |                 |                 |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-----------------|-----------------|-----------------|
|              |                           |                           |                      |                          |                           |                  |                         |                          | 30°                                 | 1°    | 1° 30'          | 2°              | 3°              |
| HLS 2012-040 | 1.2                       | 4                         | 1.8                  | 1.14                     | 16°                       | 45               | 4                       | 3,840                    | 4.13                                | 4.27  | 4.41            | 4.57            | 4.91            |
| HLS 2012-060 |                           | 6                         |                      |                          |                           | 45               | 4                       | 3,840                    | 6.19                                | 6.40  | 6.61            | 6.84            | 7.36            |
| HLS 2012-080 |                           | 8                         |                      |                          |                           | 45               | 4                       | 3,840                    | 8.26                                | 8.52  | 8.81            | 9.12            | 9.80            |
| HLS 2012-100 |                           | 10                        |                      |                          |                           | 45               | 4                       | 3,840                    | 10.32                               | 10.65 | 11.01           | 11.40           | 12.25           |
| HLS 2012-120 |                           | 12                        |                      |                          |                           | 45               | 4                       | 3,840                    | 12.38                               | 12.78 | 13.21           | 13.67           | 14.70           |
| HLS 2012-160 |                           | 16                        |                      |                          |                           | 50               | 4                       | 6,000                    | 16.51                               | 17.04 | 17.62           | 18.23           | 19.59           |
| HLS 2012-200 |                           | 20                        |                      |                          |                           | 60               | 4                       | 6,000                    | 20.63                               | 21.30 | 22.02           | 22.78           | 24.49           |
| HLS 2014-060 | 1.4                       | 6                         | 2.1                  | 1.34                     | 16°                       | 45               | 4                       | 3,960                    | 6.19                                | 6.40  | 6.61            | 6.84            | 7.36            |
| HLS 2014-080 |                           | 8                         |                      |                          |                           | 45               | 4                       | 3,960                    | 8.26                                | 8.52  | 8.81            | 9.12            | 9.80            |
| HLS 2014-100 |                           | 10                        |                      |                          |                           | 45               | 4                       | 3,960                    | 10.32                               | 10.65 | 11.01           | 11.40           | 12.25           |
| HLS 2014-120 |                           | 12                        |                      |                          |                           | 45               | 4                       | 3,960                    | 12.38                               | 12.78 | 13.21           | 13.67           | 14.70           |
| HLS 2014-140 |                           | 14                        |                      |                          |                           | 45               | 4                       | 3,960                    | 14.44                               | 14.91 | 15.42           | 15.95           | 17.15           |
| HLS 2014-160 |                           | 16                        |                      |                          |                           | 50               | 4                       | 4,560                    | 16.51                               | 17.04 | 17.62           | 18.23           | 19.59           |
| HLS 2014-220 |                           | 22                        |                      |                          |                           | 55               | 4                       | 6,120                    | 22.69                               | 23.43 | 24.22           | 25.06           | No Interference |
| HLS 2015-040 | 1.5                       | 4                         | 2.3                  | 1.44                     | 16°                       | 45               | 4                       | 3,840                    | 4.13                                | 4.27  | 4.41            | 4.57            | 4.91            |
| HLS 2015-060 |                           | 6                         |                      |                          |                           | 45               | 4                       | 3,840                    | 6.19                                | 6.40  | 6.61            | 6.84            | 7.36            |
| HLS 2015-080 |                           | 8                         |                      |                          |                           | 45               | 4                       | 3,840                    | 8.26                                | 8.52  | 8.81            | 9.12            | 9.80            |
| HLS 2015-100 |                           | 10                        |                      |                          |                           | 45               | 4                       | 3,840                    | 10.32                               | 10.65 | 11.01           | 11.40           | 12.25           |
| HLS 2015-120 |                           | 12                        |                      |                          |                           | 45               | 4                       | 3,840                    | 12.38                               | 12.78 | 13.21           | 13.67           | 14.70           |
| HLS 2015-140 |                           | 14                        |                      |                          |                           | 50               | 4                       | 3,960                    | 14.44                               | 14.91 | 15.42           | 15.95           | 17.15           |
| HLS 2015-160 |                           | 16                        |                      |                          |                           | 50               | 4                       | 3,960                    | 16.51                               | 17.04 | 17.62           | 18.23           | 19.59           |
| HLS 2015-180 |                           | 18                        |                      |                          |                           | 55               | 4                       | 3,960                    | 18.57                               | 19.17 | 19.82           | 20.51           | 22.04           |
| HLS 2015-200 |                           | 20                        |                      |                          |                           | 55               | 4                       | 3,960                    | 20.63                               | 21.30 | 22.02           | 22.78           | No Interference |
| HLS 2015-250 |                           | 25                        |                      |                          |                           | 70               | 4                       | 5,880                    | 25.79                               | 26.63 | 27.52           | 28.48           | No Interference |
| HLS 2015-300 |                           | 30                        |                      |                          |                           | 70               | 4                       | 5,880                    | 30.95                               | 31.95 | 33.02           | 34.17           | No Interference |
| HLS 2015-350 |                           | 35                        |                      |                          |                           | 70               | 4                       | 6,600                    | 36.10                               | 37.27 | 38.53           | No Interference | No Interference |
| HLS 2015-400 |                           | 40                        |                      |                          |                           | 80               | 4                       | 7,440                    | 41.26                               | 42.60 | 44.03           | No Interference | No Interference |
| HLS 2015-450 |                           | 45                        |                      |                          |                           | 80               | 4                       | 7,440                    | 46.42                               | 47.92 | No Interference | No Interference | No Interference |
| HLS 2016-060 |                           | 1.6                       |                      |                          |                           | 6                | 2.4                     | 1.51                     | 16°                                 | 45    | 4               | 3,960           | 6.23            |
| HLS 2016-080 | 8                         |                           | 45                   | 4                        | 3,960                     | 8.29             |                         |                          |                                     | 8.56  | 8.85            | 9.16            | 9.85            |
| HLS 2016-100 | 10                        |                           | 45                   | 4                        | 3,960                     | 10.35            |                         |                          |                                     | 10.69 | 11.05           | 11.43           | 12.29           |
| HLS 2016-120 | 12                        |                           | 45                   | 4                        | 3,960                     | 12.42            |                         |                          |                                     | 12.82 | 13.25           | 13.71           | 14.74           |
| HLS 2016-140 | 14                        |                           | 50                   | 4                        | 3,960                     | 14.48            |                         |                          |                                     | 14.95 | 15.45           | 15.99           | 17.19           |
| HLS 2016-160 | 16                        |                           | 50                   | 4                        | 3,960                     | 16.54            |                         |                          |                                     | 17.08 | 17.65           | 18.27           | 19.63           |
| HLS 2016-180 | 18                        |                           | 55                   | 4                        | 3,960                     | 18.60            |                         |                          |                                     | 19.21 | 19.85           | 20.54           | 22.08           |
| HLS 2016-200 | 20                        |                           | 55                   | 4                        | 3,960                     | 20.67            |                         |                          |                                     | 21.34 | 22.05           | 22.82           | No Interference |
| HLS 2016-260 | 26                        |                           | 60                   | 4                        | 6,120                     | 26.85            |                         |                          |                                     | 27.73 | 28.66           | 29.65           | No Interference |

3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |       |       |       |                 |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-------|-------|-------|-----------------|
|              |                           |                           |                      |                          |                       |                  |                         |                          | 30'                                 | 1°              | 1° 30'          | 2°              | 3°              |       |       |       |                 |
| HLS 2018-060 | 1.8                       | 6                         | 2.7                  | 1.71                     | 16°                   | 45               | 4                       | 3,960                    | 6.23                                | 6.43            | 6.65            | 6.88            | 7.40            |       |       |       |                 |
| HLS 2018-080 |                           | 8                         |                      |                          |                       | 45               | 4                       | 3,960                    | 8.29                                | 8.56            | 8.85            | 9.16            | 9.85            |       |       |       |                 |
| HLS 2018-100 |                           | 10                        |                      |                          |                       | 45               | 4                       | 3,960                    | 10.35                               | 10.69           | 11.05           | 11.43           | 12.29           |       |       |       |                 |
| HLS 2018-120 |                           | 12                        |                      |                          |                       | 45               | 4                       | 3,960                    | 12.42                               | 12.82           | 13.25           | 13.71           | 14.74           |       |       |       |                 |
| HLS 2018-140 |                           | 14                        |                      |                          |                       | 50               | 4                       | 3,960                    | 14.48                               | 14.95           | 15.45           | 15.99           | 17.19           |       |       |       |                 |
| HLS 2018-160 |                           | 16                        |                      |                          |                       | 50               | 4                       | 3,960                    | 16.54                               | 17.08           | 17.65           | 18.27           | 19.63           |       |       |       |                 |
| HLS 2018-180 |                           | 18                        |                      |                          |                       | 55               | 4                       | 3,960                    | 18.60                               | 19.21           | 19.85           | 20.54           | No Interference |       |       |       |                 |
| HLS 2018-200 |                           | 20                        |                      |                          |                       | 55               | 4                       | 3,960                    | 20.67                               | 21.34           | 22.05           | 22.82           | No Interference |       |       |       |                 |
| HLS 2018-250 |                           | 25                        |                      |                          |                       | 60               | 4                       | 5,520                    | 25.82                               | 26.66           | 27.56           | 28.52           | No Interference |       |       |       |                 |
| HLS 2020-060 |                           | 2                         |                      |                          |                       | 6                | 3                       | 1.91                     | 16°                                 | 45              | 4               | 3,840           | 6.23            | 6.43  | 6.65  | 6.88  | 7.40            |
| HLS 2020-080 | 8                         |                           | 45                   | 4                        | 3,840                 | 8.29             |                         |                          |                                     | 8.56            | 8.85            | 9.16            | 9.85            |       |       |       |                 |
| HLS 2020-100 | 10                        |                           | 45                   | 4                        | 3,840                 | 10.35            |                         |                          |                                     | 10.69           | 11.05           | 11.44           | 12.29           |       |       |       |                 |
| HLS 2020-120 | 12                        |                           | 45                   | 4                        | 3,840                 | 12.42            |                         |                          |                                     | 12.82           | 13.25           | 13.71           | 14.74           |       |       |       |                 |
| HLS 2020-140 | 14                        |                           | 50                   | 4                        | 3,840                 | 14.48            |                         |                          |                                     | 14.95           | 15.45           | 15.99           | 17.19           |       |       |       |                 |
| HLS 2020-160 | 16                        |                           | 50                   | 4                        | 3,840                 | 16.54            |                         |                          |                                     | 17.08           | 17.65           | 18.27           | No Interference |       |       |       |                 |
| HLS 2020-180 | 18                        |                           | 55                   | 4                        | 3,840                 | 18.61            |                         |                          |                                     | 19.21           | 19.86           | 20.55           | No Interference |       |       |       |                 |
| HLS 2020-200 | 20                        |                           | 55                   | 4                        | 3,840                 | 20.67            |                         |                          |                                     | 21.34           | 22.05           | 22.82           | No Interference |       |       |       |                 |
| HLS 2020-250 | 25                        |                           | 60                   | 4                        | 3,840                 | 25.83            |                         |                          |                                     | 26.66           | 27.56           | 28.52           | No Interference |       |       |       |                 |
| HLS 2020-300 | 30                        |                           | 70                   | 4                        | 4,680                 | 30.98            |                         |                          |                                     | 31.99           | 33.06           | No Interference | No Interference |       |       |       |                 |
| HLS 2020-350 | 35                        |                           | 80                   | 4                        | 5,640                 | 36.14            |                         |                          |                                     | 37.31           | 38.56           | No Interference | No Interference |       |       |       |                 |
| HLS 2020-400 | 40                        |                           | 90                   | 4                        | 7,080                 | 41.30            |                         |                          |                                     | 42.64           | No Interference | No Interference | No Interference |       |       |       |                 |
| HLS 2020-500 | 50                        |                           | 100                  | 4                        | 8,520                 | 51.61            |                         |                          |                                     | 53.28           | No Interference | No Interference | No Interference |       |       |       |                 |
| HLS 2020-600 | 60                        |                           | 110                  | 4                        | 10,200                | 61.92            |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |       |       |       |                 |
| HLS 2025-080 | 2.5                       |                           | 8                    | 3.7                      | 2.41                  | 16°              |                         |                          |                                     | 45              | 4               | 3,960           | 8.29            | 8.56  | 8.85  | 9.16  | 9.85            |
| HLS 2025-100 |                           |                           | 10                   |                          |                       |                  |                         |                          |                                     | 45              | 4               | 3,960           | 10.35           | 10.69 | 11.05 | 11.44 | 12.29           |
| HLS 2025-120 |                           |                           | 12                   |                          |                       |                  |                         |                          |                                     | 45              | 4               | 3,960           | 12.42           | 12.82 | 13.25 | 13.71 | No Interference |
| HLS 2025-140 |                           |                           | 14                   |                          |                       |                  |                         |                          |                                     | 50              | 4               | 3,960           | 14.48           | 14.95 | 15.45 | 15.99 | No Interference |
| HLS 2025-160 |                           |                           | 16                   |                          |                       |                  |                         |                          |                                     | 50              | 4               | 3,960           | 16.54           | 17.08 | 17.65 | 18.27 | No Interference |
| HLS 2025-180 |                           |                           | 18                   |                          |                       |                  |                         |                          |                                     | 55              | 4               | 3,960           | 18.61           | 19.21 | 19.86 | 20.55 | No Interference |
| HLS 2025-200 |                           | 20                        | 55                   |                          |                       |                  | 4                       | 3,960                    | 20.67                               | 21.34           | 22.06           | No Interference | No Interference |       |       |       |                 |
| HLS 2025-250 |                           | 25                        | 60                   |                          |                       |                  | 4                       | 4,320                    | 25.83                               | 26.66           | 27.56           | No Interference | No Interference |       |       |       |                 |
| HLS 2025-300 |                           | 30                        | 70                   |                          |                       |                  | 4                       | 4,320                    | 30.98                               | 31.99           | No Interference | No Interference | No Interference |       |       |       |                 |
| HLS 2025-400 |                           | 40                        | 90                   |                          |                       |                  | 4                       | 6,000                    | 41.30                               | 42.64           | No Interference | No Interference | No Interference |       |       |       |                 |
| HLS 2025-500 |                           | 50                        | 100                  |                          |                       |                  | 4                       | 7,440                    | 51.61                               | No Interference | No Interference | No Interference | No Interference |       |       |       |                 |

- $\phi 3mm$  Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|              |                           |                           |                      |                          |                       |                  |                         |                          | 30'                                 | 1°              | 1° 30'          | 2°              | 3°              |
| HLS 2030-080 | 3                         | 8                         | 4.5                  | 2.92                     | 16°                   | 45               | 6                       | 5,160                    | 8.29                                | 8.56            | 8.85            | 9.16            | 9.84            |
| HLS 2030-100 |                           | 10                        |                      |                          |                       | 45               | 6                       | 5,160                    | 10.35                               | 10.69           | 11.05           | 11.43           | 12.29           |
| HLS 2030-120 |                           | 12                        |                      |                          |                       | 50               | 6                       | 5,160                    | 12.41                               | 12.82           | 13.25           | 13.71           | 14.74           |
| HLS 2030-140 |                           | 14                        |                      |                          |                       | 50               | 6                       | 5,160                    | 14.48                               | 14.95           | 15.45           | 15.99           | 17.18           |
| HLS 2030-160 |                           | 16                        |                      |                          |                       | 60               | 6                       | 5,160                    | 16.54                               | 17.08           | 17.65           | 18.26           | 19.63           |
| HLS 2030-180 |                           | 18                        |                      |                          |                       | 60               | 6                       | 5,160                    | 18.60                               | 19.21           | 19.85           | 20.54           | 22.08           |
| HLS 2030-200 |                           | 20                        |                      |                          |                       | 60               | 6                       | 5,160                    | 20.66                               | 21.34           | 22.05           | 22.82           | 24.53           |
| HLS 2030-250 |                           | 25                        |                      |                          |                       | 70               | 6                       | 5,160                    | 25.82                               | 26.66           | 27.56           | 28.51           | No Interference |
| HLS 2030-300 |                           | 30                        |                      |                          |                       | 80               | 6                       | 6,120                    | 30.98                               | 31.98           | 33.06           | 34.21           | No Interference |
| HLS 2030-350 |                           | 35                        |                      |                          |                       | 80               | 6                       | 6,360                    | 36.14                               | 37.31           | 38.56           | 39.90           | No Interference |
| HLS 2030-400 |                           | 40                        |                      |                          |                       | 90               | 6                       | 6,360                    | 41.29                               | 42.63           | 44.06           | No Interference | No Interference |
| HLS 2030-500 |                           | 50                        |                      |                          |                       | 100              | 6                       | 8,880                    | 51.61                               | 53.28           | 55.07           | No Interference | No Interference |
| HLS 2040-120 | 4                         | 12                        | 6                    | 3.82                     | 16°                   | 50               | 6                       | 5,880                    | 12.59                               | 13.00           | 13.44           | 13.91           | 14.95           |
| HLS 2040-160 |                           | 16                        |                      |                          |                       | 60               | 6                       | 5,880                    | 16.72                               | 17.26           | 17.84           | 18.46           | No Interference |
| HLS 2040-200 |                           | 20                        |                      |                          |                       | 60               | 6                       | 5,880                    | 20.84                               | 21.52           | 22.24           | 23.02           | No Interference |
| HLS 2040-250 |                           | 25                        |                      |                          |                       | 70               | 6                       | 5,880                    | 26.00                               | 26.85           | 27.75           | 28.71           | No Interference |
| HLS 2040-300 |                           | 30                        |                      |                          |                       | 70               | 6                       | 5,880                    | 31.16                               | 32.17           | 33.25           | No Interference | No Interference |
| HLS 2040-350 |                           | 35                        |                      |                          |                       | 80               | 6                       | 5,880                    | 36.32                               | 37.49           | 38.75           | No Interference | No Interference |
| HLS 2040-400 |                           | 40                        |                      |                          |                       | 90               | 6                       | 7,440                    | 41.47                               | 42.82           | No Interference | No Interference | No Interference |
| HLS 2040-450 |                           | 45                        |                      |                          |                       | 90               | 6                       | 9,000                    | 46.63                               | 48.14           | No Interference | No Interference | No Interference |
| HLS 2040-500 |                           | 50                        |                      |                          |                       | 100              | 6                       | 11,040                   | 51.79                               | 53.47           | No Interference | No Interference | No Interference |
| HLS 2040-600 |                           | 60                        |                      |                          |                       | 110              | 6                       | 13,680                   | 62.10                               | No Interference | No Interference | No Interference | No Interference |
| HLS 2050-160 | 5                         | 16                        | 7.5                  | 4.82                     | 16°                   | 60               | 6                       | 7,440                    | 16.72                               | 17.26           | 17.84           | No Interference | No Interference |
| HLS 2050-200 |                           | 20                        |                      |                          |                       | 60               | 6                       | 7,440                    | 20.84                               | 21.52           | No Interference | No Interference | No Interference |
| HLS 2050-250 |                           | 25                        |                      |                          |                       | 60               | 6                       | 7,440                    | 26.00                               | 26.85           | No Interference | No Interference | No Interference |
| HLS 2050-300 |                           | 30                        |                      |                          |                       | 80               | 6                       | 7,440                    | 31.16                               | No Interference | No Interference | No Interference | No Interference |
| HLS 2050-350 |                           | 35                        |                      |                          |                       | 80               | 6                       | 7,440                    | 36.32                               | No Interference | No Interference | No Interference | No Interference |
| HLS 2050-400 |                           | 40                        |                      |                          |                       | 80               | 6                       | 7,440                    | 41.47                               | No Interference | No Interference | No Interference | No Interference |
| HLS 2050-500 |                           | 50                        |                      |                          |                       | 110              | 6                       | 11,760                   | 51.79                               | No Interference | No Interference | No Interference | No Interference |
| HLS 2050-600 |                           | 60                        |                      |                          |                       | 120              | 6                       | 14,400                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLS 2060-200 | 6                         | 20                        | 9                    | 5.82                     | —                     | 80               | 6                       | 7,680                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLS 2060-300 |                           | 30                        |                      |                          |                       | 80               | 6                       | 7,920                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLS 2060-400 |                           | 40                        |                      |                          |                       | 100              | 6                       | 9,240                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLS 2060-500 |                           | 50                        |                      |                          |                       | 120              | 6                       | 11,760                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLS 2060-600 |                           | 60                        |                      |                          |                       | 120              | 6                       | 15,000                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |

ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for HLS (2 Flutes)

| WORK MATERIAL |                       |                       | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD(30~45HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                           | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001          | 0.1                   | 0.3                   | 30,000                                   | 30                 | 0.003~0.005                     | 0.035                            | 30,000  | 15                 | 0.002~0.005                     | 0.035                            | 30,000   | 16                 | 0.001~0.004                     | 0.035                            |
|               |                       | 0.5                   | 28,000                                   | 28                 | 0.002~0.005                     | 0.03                             | 28,000  | 14                 | 0.002~0.004                     | 0.03                             | 28,000   | 14                 | 0.001~0.003                     | 0.03                             |
|               |                       | 0.75                  | 26,000                                   | 26                 | 0.002~0.003                     | 0.01                             | 26,000  | 13                 | 0.001~0.002                     | 0.01                             | 26,000   | 13                 | 0.001~0.002                     | 0.01                             |
|               |                       | 1                     | 24,000                                   | 24                 | 0.002~0.003                     | 0.005                            | 24,000  | 12                 | 0.001~0.002                     | 0.005                            | 24,000   | 12                 | 0.001~0.002                     | 0.005                            |
| 20015         | 0.15                  | 0.5                   | 30,000                                   | 90                 | 0.004~0.007                     | 0.07                             | 30,000  | 80                 | 0.003~0.006                     | 0.07                             | 30,000   | 70                 | 0.003~0.005                     | 0.07                             |
|               |                       | 0.75                  | 28,700                                   | 90                 | 0.003~0.007                     | 0.032                            | 28,700  | 80                 | 0.002~0.006                     | 0.032                            | 28,700   | 70                 | 0.002~0.005                     | 0.032                            |
|               |                       | 1                     | 27,300                                   | 80                 | 0.002~0.006                     | 0.015                            | 27,300  | 70                 | 0.001~0.005                     | 0.015                            | 27,300   | 60                 | 0.001~0.004                     | 0.015                            |
| 2002          | 0.2                   | 0.5                   | 56,000                                   | 340                | 0.005~0.009                     | 0.13                             | 56,000  | 310                | 0.005~0.008                     | 0.13                             | 56,000   | 270                | 0.004~0.006                     | 0.13                             |
|               |                       | 1                     | 50,900                                   | 290                | 0.003~0.007                     | 0.035                            | 50,900  | 260                | 0.003~0.006                     | 0.035                            | 50,900   | 230                | 0.002~0.004                     | 0.035                            |
|               |                       | 1.5                   | 48,200                                   | 250                | 0.003~0.004                     | 0.012                            | 48,200  | 230                | 0.002~0.003                     | 0.012                            | 48,200   | 200                | 0.001~0.002                     | 0.012                            |
|               |                       | 2                     | 43,500                                   | 190                | 0.001~0.002                     | 0.003                            | 43,500  | 170                | 0.001~0.002                     | 0.003                            | 43,500   | 150                | 0.001~0.002                     | 0.003                            |
|               |                       | 3                     | 41,300                                   | 160                | 0.001~0.001                     | 0.002                            | 41,300  | 145                | 0.001~0.001                     | 0.002                            | 41,300   | 130                | 0.001~0.001                     | 0.002                            |
| 2003          | 0.3                   | 1                     | 60,000                                   | 560                | 0.009~0.015                     | 0.101                            | 60,000  | 500                | 0.008~0.013                     | 0.101                            | 60,000   | 440                | 0.006~0.01                      | 0.101                            |
|               |                       | 1.5                   | 50,800                                   | 460                | 0.008~0.013                     | 0.05                             | 50,800  | 410                | 0.007~0.011                     | 0.05                             | 50,800   | 360                | 0.005~0.009                     | 0.05                             |
|               |                       | 2                     | 41,500                                   | 350                | 0.006~0.01                      | 0.023                            | 41,500  | 320                | 0.005~0.009                     | 0.023                            | 41,500   | 280                | 0.004~0.007                     | 0.023                            |
|               |                       | 2.5                   | 36,700                                   | 300                | 0.004~0.005                     | 0.012                            | 36,700  | 270                | 0.004~0.006                     | 0.012                            | 36,700   | 240                | 0.003~0.005                     | 0.012                            |
|               |                       | 3                     | 31,900                                   | 240                | 0.002~0.004                     | 0.008                            | 31,900  | 220                | 0.002~0.003                     | 0.008                            | 31,900   | 190                | 0.001~0.002                     | 0.008                            |
|               |                       | 4                     | 26,200                                   | 170                | 0.001~0.002                     | 0.003                            | 26,200  | 160                | 0.001~0.002                     | 0.003                            | 26,200   | 140                | 0.001~0.001                     | 0.003                            |
|               |                       | 6                     | 20,400                                   | 100                | 0.001~0.001                     | —                                | 20,400  | 90                 | 0.001~0.001                     | —                                | 20,400   | 80                 | 0.001~0.001                     | —                                |
|               |                       | 9                     | 15,700                                   | 30                 | 0.001~0.001                     | —                                | 15,700  | 30                 | 0.001~0.001                     | —                                | 15,700   | 30                 | 0.001~0.001                     | —                                |
| 2004          | 0.4                   | 1.5                   | 52,700                                   | 660                | 0.011~0.016                     | 0.095                            | 57,700  | 640                | 0.009~0.015                     | 0.095                            | 48,100   | 470                | 0.007~0.012                     | 0.095                            |
|               |                       | 2                     | 50,000                                   | 610                | 0.009~0.014                     | 0.052                            | 53,000  | 580                | 0.008~0.013                     | 0.052                            | 44,600   | 430                | 0.006~0.01                      | 0.052                            |
|               |                       | 2.5                   | 47,300                                   | 560                | 0.007~0.012                     | 0.026                            | 48,300  | 520                | 0.007~0.011                     | 0.026                            | 41,100   | 390                | 0.005~0.008                     | 0.026                            |
|               |                       | 3                     | 44,500                                   | 510                | 0.005~0.009                     | 0.018                            | 43,600  | 450                | 0.005~0.008                     | 0.018                            | 37,500   | 340                | 0.004~0.006                     | 0.018                            |
|               |                       | 3.5                   | 42,800                                   | 480                | 0.005~0.008                     | 0.01                             | 40,800  | 410                | 0.004~0.009                     | 0.01                             | 35,300   | 310                | 0.004~0.005                     | 0.01                             |
|               |                       | 4                     | 41,000                                   | 440                | 0.004~0.006                     | 0.008                            | 38,000  | 360                | 0.003~0.005                     | 0.008                            | 33,100   | 280                | 0.003~0.004                     | 0.008                            |
|               |                       | 5                     | 38,500                                   | 380                | 0.003~0.004                     | 0.004                            | 34,200  | 300                | 0.002~0.004                     | 0.004                            | 30,100   | 240                | 0.002~0.003                     | 0.004                            |
|               |                       | 8                     | 33,700                                   | 260                | 0.001~0.002                     | 0.001                            | 27,300  | 190                | 0.001~0.002                     | 0.001                            | 24,600   | 150                | 0.001~0.002                     | 0.001                            |
|               |                       | 12                    | 30,000                                   | 140                | 0.001~0.001                     | —                                | 22,500  | 100                | 0.001~0.001                     | —                                | 20,700   | 80                 | 0.001~0.001                     | —                                |
| 2005          | 0.5                   | 1.5                   | 63,100                                   | 1,020              | 0.019~0.029                     | 0.139                            | 61,000  | 870                | 0.017~0.027                     | 0.139                            | 46,500   | 610                | 0.013~0.02                      | 0.139                            |
|               |                       | 2                     | 56,800                                   | 900                | 0.015~0.025                     | 0.098                            | 54,000  | 760                | 0.014~0.023                     | 0.098                            | 40,600   | 510                | 0.011~0.018                     | 0.098                            |
|               |                       | 2.5                   | 50,500                                   | 780                | 0.011~0.021                     | 0.057                            | 47,000  | 650                | 0.011~0.019                     | 0.057                            | 34,700   | 410                | 0.009~0.016                     | 0.057                            |
|               |                       | 3                     | 44,200                                   | 660                | 0.007~0.016                     | 0.037                            | 39,900  | 530                | 0.008~0.015                     | 0.037                            | 32,200   | 370                | 0.007~0.011                     | 0.037                            |
|               |                       | 4                     | 40,600                                   | 580                | 0.008~0.013                     | 0.016                            | 36,100  | 460                | 0.007~0.012                     | 0.016                            | 29,700   | 330                | 0.006~0.009                     | 0.016                            |
|               |                       | 5                     | 37,000                                   | 500                | 0.006~0.01                      | 0.008                            | 32,300  | 390                | 0.006~0.009                     | 0.008                            | 27,200   | 290                | 0.005~0.007                     | 0.008                            |
|               |                       | 6                     | 33,400                                   | 420                | 0.004~0.007                     | 0.005                            | 28,500  | 320                | 0.004~0.006                     | 0.005                            | 24,700   | 250                | 0.003~0.005                     | 0.005                            |
|               |                       | 8                     | 29,100                                   | 320                | 0.002~0.003                     | 0.002                            | 24,100  | 240                | 0.002~0.003                     | 0.002                            | 21,600   | 190                | 0.001~0.003                     | 0.002                            |
|               |                       | 10                    | 26,100                                   | 250                | 0.001~0.002                     | 0.001                            | 21,200  | 180                | 0.001~0.002                     | 0.001                            | 19,600   | 150                | 0.001~0.002                     | 0.001                            |
|               |                       | 15                    | 21,500                                   | 120                | 0.001~0.001                     | —                                | 16,700  | 80                 | 0.001~0.001                     | —                                | 16,300   | 70                 | 0.001~0.001                     | —                                |
| 2006          | 0.6                   | 2                     | 63,600                                   | 1,240              | 0.023~0.038                     | 0.18                             | 53,300  | 930                | 0.02~0.034                      | 0.18                             | 39,100   | 600                | 0.016~0.026                     | 0.18                             |
|               |                       | 3                     | 52,500                                   | 990                | 0.018~0.03                      | 0.075                            | 44,000  | 740                | 0.016~0.026                     | 0.075                            | 33,500   | 500                | 0.013~0.02                      | 0.075                            |
|               |                       | 4                     | 41,300                                   | 740                | 0.012~0.021                     | 0.03                             | 34,700  | 550                | 0.011~0.018                     | 0.03                             | 27,900   | 390                | 0.009~0.014                     | 0.03                             |
|               |                       | 5                     | 36,700                                   | 630                | 0.01~0.017                      | 0.017                            | 30,900  | 470                | 0.009~0.014                     | 0.017                            | 25,500   | 340                | 0.007~0.011                     | 0.017                            |
|               |                       | 6                     | 32,100                                   | 520                | 0.007~0.012                     | 0.01                             | 27,000  | 390                | 0.006~0.01                      | 0.01                             | 23,000   | 290                | 0.005~0.008                     | 0.01                             |
|               |                       | 7                     | 29,500                                   | 460                | 0.006~0.01                      | 0.005                            | 24,800  | 350                | 0.005~0.008                     | 0.005                            | 21,500   | 260                | 0.004~0.006                     | 0.005                            |
|               |                       | 8                     | 26,800                                   | 390                | 0.004~0.007                     | 0.004                            | 22,600  | 300                | 0.004~0.006                     | 0.004                            | 20,000   | 230                | 0.003~0.005                     | 0.004                            |
|               |                       | 10                    | 23,400                                   | 300                | 0.002~0.004                     | 0.002                            | 19,700  | 230                | 0.002~0.004                     | 0.002                            | 17,900   | 180                | 0.002~0.003                     | 0.002                            |
|               |                       | 12                    | 20,900                                   | 240                | 0.002~0.003                     | 0.001                            | 17,600  | 180                | 0.002~0.002                     | 0.001                            | 16,400   | 150                | 0.001~0.002                     | 0.001                            |
| 18            | 16,200                | 100                   | 0.001~0.001                              | —                  | 13,700                          | 80                               | 0.001~0.001                                   | —                  | 13,500                          | 70                               | 0.001~0.001  | —                  |                                 |                                  |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for HLS (2 Flutes)

| WORK MATERIAL |                       |                       | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                    |                                     | HARDENED STEELS<br>SKD / SKH<br>(55~60HRC) |                    |                                    |                                     |
|---------------|-----------------------|-----------------------|--|--------------------|------------------------------------|-------------------------------------|--|--------------------|------------------------------------|-------------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) |
| 2001          | 0.1                   | 0.3                   | —  | —                  | — ~ —                              | 0.035                               | —  | —                  | — ~ —                              | 0.035                               |
|               |                       | 0.5                   | —  | —                  | — ~ —                              | 0.03                                | —  | —                  | — ~ —                              | 0.03                                |
|               |                       | 0.75                  | —  | —                  | — ~ —                              | —                                   | —  | —                  | — ~ —                              | —                                   |
|               |                       | 1                     | —  | —                  | — ~ —                              | —                                   | —  | —                  | — ~ —                              | —                                   |
| 20015         | 0.15                  | 0.5                   | 30,000                                     | 50                 | 0.003~0.004                        | 0.07                                | —  | —                  | — ~ —                              | 0.07                                |
|               |                       | 0.75                  | 28,700                                     | 50                 | 0.002~0.004                        | 0.032                               | —  | —                  | — ~ —                              | 0.032                               |
|               |                       | 1                     | 27,300                                     | 40                 | 0.001~0.003                        | 0.015                               | —  | —                  | — ~ —                              | 0.015                               |
| 2002          | 0.2                   | 0.5                   | 44,800                                     | 180                | 0.003~0.004                        | 0.13                                | 15,000                                     | 10                 | 0.001~0.002                        | 0.13                                |
|               |                       | 1                     | 40,800                                     | 160                | 0.001~0.002                        | 0.035                               | —  | —                  | — ~ —                              | 0.035                               |
|               |                       | 1.5                   | 38,500                                     | 140                | 0.001~0.001                        | 0.012                               | —  | —                  | — ~ —                              | 0.012                               |
|               |                       | 2                     | 34,500                                     | 100                | 0.001~0.001                        | 0.003                               | —  | —                  | — ~ —                              | —                                   |
|               |                       | 3                     | 32,600                                     | 80                 | 0.001~0.001                        | 0.002                               | —  | —                  | — ~ —                              | —                                   |
| 2003          | 0.3                   | 1                     | 52,100                                     | 330                | 0.004~0.007                        | 0.101                               | 14,600                                     | 14                 | 0.003~0.004                        | 0.101                               |
|               |                       | 1.5                   | 42,700                                     | 260                | 0.004~0.006                        | 0.05                                | 14,600                                     | 13                 | 0.003~0.004                        | 0.05                                |
|               |                       | 2                     | 33,200                                     | 190                | 0.003~0.005                        | 0.023                               | 14,600                                     | 12                 | 0.002~0.003                        | 0.023                               |
|               |                       | 2.5                   | 29,400                                     | 160                | 0.002~0.004                        | 0.012                               | 14,600                                     | 11                 | 0.001~0.002                        | 0.012                               |
|               |                       | 3                     | 25,500                                     | 130                | 0.001~0.002                        | 0.008                               | 14,600                                     | 10                 | 0.001~0.001                        | 0.008                               |
|               |                       | 4                     | 20,900                                     | 100                | 0.001~0.001                        | 0.003                               | 14,600                                     | 9                  | 0.001~0.001                        | 0.003                               |
|               |                       | 6                     | 16,300                                     | 60                 | 0.001~0.001                        | —                                   | —  | —                  | — ~ —                              | —                                   |
| 2004          | 0.4                   | 1.5                   | 38,500                                     | 320                | 0.004~0.008                        | 0.095                               | 14,300                                     | 17                 | 0.003~0.004                        | 0.095                               |
|               |                       | 2                     | 35,700                                     | 290                | 0.004~0.007                        | 0.052                               | 14,300                                     | 17                 | 0.003~0.004                        | 0.052                               |
|               |                       | 2.5                   | 32,900                                     | 260                | 0.004~0.006                        | 0.026                               | 14,300                                     | 17                 | 0.003~0.004                        | 0.026                               |
|               |                       | 3                     | 30,000                                     | 230                | 0.003~0.005                        | 0.018                               | 14,300                                     | 16                 | 0.002~0.003                        | 0.018                               |
|               |                       | 3.5                   | 28,300                                     | 210                | 0.003~0.004                        | 0.01                                | 14,300                                     | 16                 | 0.002~0.003                        | 0.01                                |
|               |                       | 4                     | 26,500                                     | 190                | 0.002~0.003                        | 0.008                               | 14,300                                     | 15                 | 0.001~0.002                        | 0.008                               |
|               |                       | 5                     | 24,100                                     | 160                | 0.001~0.002                        | 0.004                               | 14,300                                     | 14                 | 0.001~0.001                        | 0.004                               |
|               |                       | 8                     | 19,700                                     | 100                | 0.001~0.001                        | 0.001                               | 14,300                                     | 11                 | 0.001~0.001                        | 0.001                               |
| 2005          | 0.5                   | 1.5                   | 37,300                                     | 410                | 0.009~0.015                        | 0.139                               | 14,000                                     | 20                 | 0.004~0.008                        | 0.139                               |
|               |                       | 2                     | 32,500                                     | 350                | 0.008~0.013                        | 0.098                               | 14,000                                     | 20                 | 0.004~0.007                        | 0.098                               |
|               |                       | 2.5                   | 27,700                                     | 290                | 0.007~0.011                        | 0.057                               | 14,000                                     | 20                 | 0.004~0.006                        | 0.057                               |
|               |                       | 3                     | 25,700                                     | 260                | 0.005~0.009                        | 0.037                               | 14,000                                     | 19                 | 0.004~0.005                        | 0.037                               |
|               |                       | 4                     | 23,700                                     | 230                | 0.004~0.007                        | 0.016                               | 14,000                                     | 18                 | 0.003~0.004                        | 0.016                               |
|               |                       | 5                     | 21,700                                     | 200                | 0.003~0.005                        | 0.008                               | 14,000                                     | 17                 | 0.002~0.003                        | 0.008                               |
|               |                       | 6                     | 19,700                                     | 170                | 0.002~0.003                        | 0.005                               | 14,000                                     | 16                 | 0.001~0.002                        | 0.005                               |
|               |                       | 8                     | 17,300                                     | 130                | 0.001~0.002                        | 0.002                               | 14,000                                     | 14                 | 0.001~0.001                        | 0.002                               |
|               |                       | 10                    | 15,600                                     | 100                | 0.001~0.001                        | 0.001                               | 14,000                                     | 12                 | 0.001~0.001                        | 0.001                               |
| 2006          | 0.6                   | 15                    | 13,000                                     | 50                 | 0.001~0.001                        | —                                   | —  | —                  | — ~ —                              | —                                   |
|               |                       | 2                     | 31,300                                     | 410                | 0.011~0.019                        | 0.18                                | 12,000                                     | 23                 | 0.006~0.01                         | 0.18                                |
|               |                       | 3                     | 26,800                                     | 340                | 0.009~0.015                        | 0.075                               | 12,000                                     | 22                 | 0.005~0.008                        | 0.075                               |
|               |                       | 4                     | 22,300                                     | 270                | 0.006~0.01                         | 0.03                                | 12,000                                     | 21                 | 0.003~0.005                        | 0.03                                |
|               |                       | 5                     | 20,400                                     | 240                | 0.005~0.008                        | 0.017                               | 12,000                                     | 20                 | 0.003~0.004                        | 0.017                               |
|               |                       | 6                     | 18,400                                     | 200                | 0.003~0.006                        | 0.01                                | 12,000                                     | 19                 | 0.002~0.003                        | 0.01                                |
|               |                       | 7                     | 17,200                                     | 180                | 0.003~0.005                        | 0.005                               | 12,000                                     | 18                 | 0.002~0.003                        | 0.005                               |
|               |                       | 8                     | 16,000                                     | 160                | 0.002~0.003                        | 0.004                               | 12,000                                     | 17                 | 0.001~0.002                        | 0.004                               |
|               |                       | 10                    | 14,300                                     | 130                | 0.001~0.002                        | 0.002                               | 12,000                                     | 15                 | 0.001~0.001                        | 0.002                               |
|               |                       | 12                    | 13,100                                     | 100                | 0.001~0.001                        | 0.001                               | 12,000                                     | 13                 | 0.001~0.001                        | 0.001                               |
| 18            | 10,800                | 50                    | 0.001~0.001                                | —                  | —                                  | —                                   | —  | — ~ —              | —                                  |                                     |

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for HLS (2 Flutes)

| WORK MATERIAL |                       |                       | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD(30~45HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                           | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2007          | 0.7                   | 2                     | 59,800                                   | 1,380              | 0.03 ~0.05                      | 0.165                            | 50,200  | 1,040              | 0.027~0.045                     | 0.165                            | 36,100   | 660                | 0.021~0.035                     | 0.165                            |
|               |                       | 4                     | 38,900                                   | 840                | 0.017~0.029                     | 0.047                            | 32,700  | 630                | 0.015~0.026                     | 0.047                            | 25,800   | 440                | 0.012~0.02                      | 0.047                            |
|               |                       | 6                     | 30,200                                   | 600                | 0.01 ~0.017                     | 0.014                            | 25,400  | 450                | 0.009~0.015                     | 0.014                            | 21,200   | 330                | 0.007~0.012                     | 0.014                            |
|               |                       | 8                     | 25,300                                   | 460                | 0.006~0.01                      | 0.006                            | 21,300  | 350                | 0.005~0.009                     | 0.006                            | 18,400   | 260                | 0.004~0.007                     | 0.006                            |
|               |                       | 10                    | 22,000                                   | 360                | 0.004~0.006                     | 0.004                            | 18,500  | 270                | 0.003~0.005                     | 0.004                            | 16,500   | 220                | 0.003~0.005                     | 0.004                            |
| 2008          | 0.8                   | 3                     | 41,200                                   | 1,050              | 0.033~0.053                     | 0.15                             | 34,500  | 790                | 0.029~0.049                     | 0.15                             | 26,200   | 530                | 0.023~0.038                     | 0.15                             |
|               |                       | 4                     | 37,100                                   | 930                | 0.027~0.044                     | 0.08                             | 31,100  | 700                | 0.024~0.04                      | 0.08                             | 24,100   | 480                | 0.019~0.031                     | 0.08                             |
|               |                       | 5                     | 33,000                                   | 810                | 0.021~0.035                     | 0.052                            | 27,700  | 610                | 0.019~0.031                     | 0.052                            | 22,000   | 430                | 0.015~0.024                     | 0.052                            |
|               |                       | 6                     | 28,800                                   | 680                | 0.015~0.025                     | 0.024                            | 24,200  | 510                | 0.013~0.022                     | 0.024                            | 19,800   | 370                | 0.01 ~0.017                     | 0.024                            |
|               |                       | 8                     | 24,100                                   | 520                | 0.009~0.015                     | 0.01                             | 20,300  | 390                | 0.008~0.013                     | 0.01                             | 17,200   | 300                | 0.006~0.01                      | 0.01                             |
|               |                       | 10                    | 21,000                                   | 420                | 0.006~0.009                     | 0.005                            | 17,700  | 320                | 0.005~0.008                     | 0.005                            | 15,500   | 240                | 0.004~0.007                     | 0.005                            |
|               |                       | 12                    | 18,700                                   | 340                | 0.004~0.006                     | 0.003                            | 15,800  | 260                | 0.003~0.006                     | 0.003                            | 14,100   | 200                | 0.003~0.004                     | 0.003                            |
|               |                       | 16                    | 15,600                                   | 230                | 0.002~0.003                     | 0.001                            | 13,200  | 180                | 0.002~0.003                     | 0.001                            | 12,300   | 150                | 0.002~0.002                     | 0.001                            |
| 2009          | 0.9                   | 4                     | 35,600                                   | 1,100              | 0.033~0.054                     | 0.128                            | 29,500  | 820                | 0.029~0.049                     | 0.128                            | 22,500   | 550                | 0.023~0.038                     | 0.128                            |
|               |                       | 6                     | 27,600                                   | 790                | 0.019~0.032                     | 0.038                            | 23,000  | 590                | 0.017~0.029                     | 0.038                            | 18,500   | 420                | 0.013~0.022                     | 0.038                            |
|               |                       | 8                     | 23,000                                   | 600                | 0.012~0.02                      | 0.016                            | 19,300  | 450                | 0.011~0.018                     | 0.016                            | 16,100   | 330                | 0.008~0.014                     | 0.016                            |
|               |                       | 10                    | 20,000                                   | 470                | 0.008~0.013                     | 0.008                            | 16,800  | 360                | 0.007~0.012                     | 0.008                            | 14,500   | 270                | 0.005~0.009                     | 0.008                            |
|               |                       | 15                    | 15,500                                   | 270                | 0.003~0.006                     | 0.002                            | 13,100  | 200                | 0.003~0.005                     | 0.002                            | 11,900   | 160                | 0.002~0.004                     | 0.002                            |
| 2010          | 1                     | 3                     | 37,900                                   | 1,340              | 0.048~0.067                     | 0.263                            | 31,500  | 990                | 0.043~0.072                     | 0.263                            | 23,400   | 650                | 0.034~0.057                     | 0.263                            |
|               |                       | 4                     | 34,100                                   | 1,170              | 0.04 ~0.067                     | 0.195                            | 28,400  | 870                | 0.036~0.06                      | 0.195                            | 21,500   | 580                | 0.028~0.047                     | 0.195                            |
|               |                       | 5                     | 30,300                                   | 1,000              | 0.032~0.053                     | 0.127                            | 25,300  | 750                | 0.029~0.048                     | 0.127                            | 19,600   | 510                | 0.022~0.037                     | 0.127                            |
|               |                       | 6                     | 26,500                                   | 850                | 0.023~0.039                     | 0.058                            | 22,100  | 630                | 0.021~0.035                     | 0.058                            | 17,600   | 440                | 0.016~0.027                     | 0.058                            |
|               |                       | 7                     | 24,300                                   | 760                | 0.019~0.032                     | 0.041                            | 20,400  | 560                | 0.017~0.029                     | 0.041                            | 16,500   | 400                | 0.013~0.022                     | 0.041                            |
|               |                       | 8                     | 22,100                                   | 660                | 0.014~0.024                     | 0.024                            | 18,600  | 490                | 0.013~0.022                     | 0.024                            | 15,300   | 360                | 0.01 ~0.017                     | 0.024                            |
|               |                       | 9                     | 20,700                                   | 600                | 0.012~0.02                      | 0.019                            | 17,400  | 450                | 0.011~0.018                     | 0.019                            | 14,600   | 330                | 0.009~0.014                     | 0.019                            |
|               |                       | 10                    | 19,200                                   | 530                | 0.01 ~0.016                     | 0.013                            | 16,200  | 400                | 0.009~0.014                     | 0.013                            | 13,800   | 300                | 0.007~0.011                     | 0.013                            |
|               |                       | 12                    | 17,200                                   | 440                | 0.007~0.011                     | 0.007                            | 14,500  | 330                | 0.006~0.01                      | 0.007                            | 12,600   | 250                | 0.005~0.008                     | 0.007                            |
|               |                       | 14                    | 15,600                                   | 360                | 0.005~0.008                     | 0.005                            | 13,200  | 270                | 0.004~0.007                     | 0.005                            | 11,700   | 210                | 0.003~0.006                     | 0.005                            |
|               |                       | 16                    | 14,300                                   | 300                | 0.004~0.006                     | 0.003                            | 12,100  | 230                | 0.003~0.006                     | 0.003                            | 11,000   | 180                | 0.003~0.005                     | 0.003                            |
|               |                       | 18                    | 13,400                                   | 250                | 0.003~0.005                     | 0.002                            | 11,350  | 190                | 0.002~0.004                     | 0.002                            | 10,400   | 150                | 0.002~0.004                     | 0.002                            |
|               |                       | 20                    | 12,500                                   | 200                | 0.002~0.004                     | 0.002                            | 10,600  | 160                | 0.002~0.003                     | 0.002                            | 9,800  | 130                | 0.002~0.003                     | 0.002                            |
| 2012          | 1.2                   | 30                    | 9,700                                    | 80                 | 0.001~0.002                     | —                                | 8,200   | 60                 | 0.001~0.002                     | —                                | 8,100  | 50                 | 0.001~0.002                     | —                                |
|               |                       | 4                     | 28,900                                   | 1,180              | 0.05 ~0.085                     | 0.23                             | 24,100  | 870                | 0.047~0.077                     | 0.23                             | 18,300   | 580                | 0.036~0.059                     | 0.23                             |
|               |                       | 6                     | 24,800                                   | 970                | 0.037~0.062                     | 0.12                             | 20,700  | 720                | 0.034~0.056                     | 0.12                             | 16,100   | 490                | 0.026~0.043                     | 0.12                             |
|               |                       | 8                     | 20,700                                   | 760                | 0.024~0.039                     | 0.051                            | 17,300  | 570                | 0.021~0.035                     | 0.051                            | 13,900   | 400                | 0.016~0.027                     | 0.051                            |
|               |                       | 10                    | 18,000                                   | 620                | 0.016~0.026                     | 0.026                            | 15,100  | 470                | 0.014~0.023                     | 0.026                            | 12,400   | 340                | 0.011~0.018                     | 0.026                            |
|               |                       | 12                    | 16,100                                   | 520                | 0.011~0.018                     | 0.015                            | 13,500  | 390                | 0.01 ~0.016                     | 0.015                            | 11,400   | 290                | 0.008~0.013                     | 0.015                            |
|               |                       | 16                    | 13,400                                   | 380                | 0.006~0.01                      | 0.006                            | 11,300  | 290                | 0.005~0.009                     | 0.006                            | 9,800  | 220                | 0.004~0.007                     | 0.006                            |
|               |                       | 20                    | 11,700                                   | 280                | 0.004~0.007                     | 0.003                            | 9,900   | 210                | 0.004~0.006                     | 0.003                            | 8,800  | 170                | 0.003~0.005                     | 0.003                            |
| 2014          | 1.4                   | 6                     | 23,300                                   | 1,070              | 0.052~0.086                     | 0.222                            | 19,400  | 800                | 0.047~0.078                     | 0.222                            | 14,800   | 540                | 0.036~0.061                     | 0.222                            |
|               |                       | 8                     | 19,500                                   | 850                | 0.035~0.059                     | 0.094                            | 16,300  | 640                | 0.032~0.053                     | 0.094                            | 12,900   | 440                | 0.025~0.041                     | 0.094                            |
|               |                       | 10                    | 16,900                                   | 710                | 0.025~0.041                     | 0.048                            | 14,200  | 530                | 0.022~0.037                     | 0.048                            | 11,500   | 380                | 0.017~0.029                     | 0.048                            |
|               |                       | 12                    | 15,100                                   | 600                | 0.018~0.03                      | 0.028                            | 12,700  | 450                | 0.016~0.027                     | 0.028                            | 10,500   | 330                | 0.013~0.021                     | 0.028                            |
|               |                       | 14                    | 13,700                                   | 510                | 0.013~0.022                     | 0.018                            | 11,500  | 390                | 0.012~0.02                      | 0.018                            | 9,700  | 290                | 0.009~0.016                     | 0.018                            |
|               |                       | 16                    | 12,600                                   | 450                | 0.01 ~0.017                     | 0.012                            | 10,600  | 340                | 0.009~0.015                     | 0.012                            | 9,100  | 250                | 0.007~0.012                     | 0.012                            |
|               |                       | 22                    | 10,300                                   | 300                | 0.006~0.009                     | 0.004                            | 8,700   | 230                | 0.005~0.008                     | 0.004                            | 7,800  | 180                | 0.004~0.006                     | 0.004                            |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for HLS (2 Flutes)

| WORK MATERIAL |                       |                       | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                    |                                     | HARDENED STEELS<br>SKD / SKH<br>(55~60HRC) |                    |                                    |                                     |
|---------------|-----------------------|-----------------------|--|--------------------|------------------------------------|-------------------------------------|--|--------------------|------------------------------------|-------------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) |
| 2007          | 0.7                   | 2                     | 28,800                                     | 430                | 0.015~0.025                        | 0.165                               | 10,000                                     | 24                 | 0.01 ~0.015                        | 0.165                               |
|               |                       | 4                     | 20,600                                     | 290                | 0.009~0.014                        | 0.047                               | 10,000                                     | 22                 | 0.006~0.009                        | 0.047                               |
|               |                       | 6                     | 16,900                                     | 230                | 0.005~0.008                        | 0.014                               | 10,000                                     | 20                 | 0.003~0.005                        | 0.014                               |
|               |                       | 8                     | 14,700                                     | 190                | 0.003~0.005                        | 0.006                               | 10,000                                     | 18                 | 0.002~0.003                        | 0.006                               |
|               |                       | 10                    | 13,200                                     | 160                | 0.002~0.003                        | 0.004                               | 10,000                                     | 13                 | 0.001~0.002                        | 0.004                               |
| 2008          | 0.8                   | 3                     | 21,000                                     | 370                | 0.016~0.027                        | 0.15                                | 8,000                                      | 21                 | 0.012~0.016                        | 0.15                                |
|               |                       | 4                     | 19,300                                     | 330                | 0.013~0.022                        | 0.08                                | 8,000                                      | 20                 | 0.01 ~0.013                        | 0.08                                |
|               |                       | 5                     | 17,600                                     | 290                | 0.01 ~0.017                        | 0.052                               | 8,000                                      | 19                 | 0.008~0.01                         | 0.052                               |
|               |                       | 6                     | 15,800                                     | 250                | 0.007~0.012                        | 0.024                               | 8,000                                      | 18                 | 0.005~0.007                        | 0.024                               |
|               |                       | 8                     | 13,800                                     | 200                | 0.004~0.007                        | 0.01                                | 8,000                                      | 16                 | 0.003~0.004                        | 0.01                                |
|               |                       | 10                    | 12,400                                     | 170                | 0.003~0.005                        | 0.005                               | 8,000                                      | 14                 | 0.002~0.003                        | 0.005                               |
|               |                       | 12                    | 11,300                                     | 140                | 0.002~0.003                        | 0.003                               | 8,000                                      | 12                 | 0.001~0.002                        | 0.003                               |
|               |                       | 16                    | 9,800                                      | 100                | 0.001~0.002                        | 0.001                               | —  | —                  | — ~ —                              | 0.001                               |
| 24            | 8,100                 | 50                    | 0.001~0.001                                | —                  | —                                  | —                                   | — ~ —                                      | —                  |                                    |                                     |
| 2009          | 0.9                   | 4                     | 18,000                                     | 380                | 0.016~0.027                        | 0.128                               | 7,200                                      | 20                 | 0.01 ~0.014                        | 0.128                               |
|               |                       | 6                     | 14,800                                     | 290                | 0.01 ~0.016                        | 0.038                               | 7,200                                      | 18                 | 0.007~0.009                        | 0.038                               |
|               |                       | 8                     | 12,900                                     | 230                | 0.006~0.01                         | 0.016                               | 7,200                                      | 16                 | 0.004~0.006                        | 0.016                               |
|               |                       | 10                    | 11,600                                     | 190                | 0.004~0.006                        | 0.008                               | 7,200                                      | 14                 | 0.002~0.003                        | 0.008                               |
|               |                       | 15                    | 9,500                                      | 120                | 0.002~0.003                        | 0.002                               | —  | —                  | — ~ —                              | 0.002                               |
| 2010          | 1                     | 3                     | 18,700                                     | 440                | 0.024~0.039                        | 0.263                               | 6,500                                      | 15                 | 0.011~0.016                        | 0.263                               |
|               |                       | 4                     | 17,200                                     | 400                | 0.02 ~0.033                        | 0.195                               | 6,500                                      | 15                 | 0.01 ~0.015                        | 0.195                               |
|               |                       | 5                     | 15,700                                     | 360                | 0.016~0.027                        | 0.127                               | 6,500                                      | 15                 | 0.009~0.014                        | 0.127                               |
|               |                       | 6                     | 14,100                                     | 310                | 0.012~0.02                         | 0.058                               | 6,500                                      | 14                 | 0.007~0.012                        | 0.058                               |
|               |                       | 7                     | 13,200                                     | 280                | 0.01 ~0.016                        | 0.041                               | 6,500                                      | 14                 | 0.006~0.009                        | 0.041                               |
|               |                       | 8                     | 12,300                                     | 250                | 0.007~0.012                        | 0.024                               | 6,500                                      | 13                 | 0.004~0.006                        | 0.024                               |
|               |                       | 9                     | 11,700                                     | 230                | 0.006~0.01                         | 0.019                               | 6,500                                      | 13                 | 0.004~0.005                        | 0.019                               |
|               |                       | 10                    | 11,000                                     | 210                | 0.005~0.008                        | 0.013                               | 6,500                                      | 12                 | 0.003~0.004                        | 0.013                               |
|               |                       | 12                    | 10,100                                     | 170                | 0.003~0.006                        | 0.007                               | 6,500                                      | 11                 | 0.002~0.003                        | 0.007                               |
|               |                       | 14                    | 9,400                                      | 150                | 0.002~0.004                        | 0.005                               | 6,500                                      | 10                 | 0.001~0.002                        | 0.005                               |
|               |                       | 16                    | 8,800                                      | 130                | 0.002~0.003                        | 0.003                               | —  | —                  | — ~ —                              | 0.003                               |
|               |                       | 18                    | 8,350                                      | 110                | 0.001~0.002                        | 0.002                               | —  | —                  | — ~ —                              | 0.002                               |
|               |                       | 20                    | 7,900                                      | 90                 | 0.001~0.002                        | 0.002                               | —  | —                  | — ~ —                              | 0.002                               |
| 25            | 7,100                 | 60                    | 0.001~0.001                                | 0.001              | —                                  | —                                   | — ~ —                                      | 0.001              |                                    |                                     |
| 30            | 6,500                 | 40                    | 0.001~0.001                                | —                  | —                                  | —                                   | — ~ —                                      | —                  |                                    |                                     |
| 2012          | 1.2                   | 4                     | 14,500                                     | 400                | 0.026~0.042                        | 0.23                                | 9,600                                      | 34                 | 0.015~0.026                        | 0.23                                |
|               |                       | 6                     | 12,800                                     | 340                | 0.019~0.031                        | 0.12                                | 9,600                                      | 22                 | 0.011~0.019                        | 0.12                                |
|               |                       | 8                     | 11,100                                     | 280                | 0.012~0.02                         | 0.051                               | 9,600                                      | 10                 | 0.007~0.012                        | 0.051                               |
|               |                       | 10                    | 9,900                                      | 230                | 0.008~0.013                        | 0.026                               | —  | —                  | — ~ —                              | 0.026                               |
|               |                       | 12                    | 9,100                                      | 200                | 0.005~0.009                        | 0.015                               | —  | —                  | — ~ —                              | 0.015                               |
|               |                       | 16                    | 7,900                                      | 150                | 0.003~0.005                        | 0.006                               | —  | —                  | — ~ —                              | 0.006                               |
|               |                       | 20                    | 7,000                                      | 120                | 0.002~0.003                        | 0.003                               | —  | —                  | — ~ —                              | 0.003                               |
| 2014          | 1.4                   | 6                     | 11,900                                     | 370                | 0.026~0.043                        | 0.222                               | 9,600                                      | 44                 | 0.015~0.026                        | 0.222                               |
|               |                       | 8                     | 10,300                                     | 310                | 0.018~0.029                        | 0.094                               | 9,600                                      | 18                 | 0.01 ~0.017                        | 0.094                               |
|               |                       | 10                    | 9,200                                      | 260                | 0.012~0.021                        | 0.048                               | —  | —                  | — ~ —                              | 0.048                               |
|               |                       | 12                    | 8,400                                      | 230                | 0.009~0.015                        | 0.028                               | —  | —                  | — ~ —                              | 0.028                               |
|               |                       | 14                    | 7,800                                      | 200                | 0.007~0.011                        | 0.018                               | —  | —                  | — ~ —                              | 0.018                               |
|               |                       | 16                    | 7,300                                      | 180                | 0.005~0.009                        | 0.012                               | —  | —                  | — ~ —                              | 0.012                               |
|               |                       | 22                    | 6,200                                      | 120                | 0.003~0.005                        | 0.004                               | —  | —                  | — ~ —                              | 0.004                               |

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Milling Conditions for HLS (2 Flutes)

| WORK MATERIAL |                       |                       | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD(30~45HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                           | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2015          | 1.5                   | 4                     | 26,600                                   | 1,340              | 0.073~0.12                      | 0.462                            | 22,100  | 1,000              | 0.065~0.109                     | 0.462                            | 16,300   | 640                | 0.051~0.084                     | 0.462                            |
|               |                       | 6                     | 22,800                                   | 1,120              | 0.057~0.094                     | 0.293                            | 19,000  | 840                | 0.051~0.085                     | 0.293                            | 14,400   | 550                | 0.04~0.066                      | 0.293                            |
|               |                       | 8                     | 19,000                                   | 900                | 0.041~0.068                     | 0.124                            | 15,900  | 670                | 0.037~0.061                     | 0.124                            | 12,500   | 460                | 0.029~0.048                     | 0.124                            |
|               |                       | 10                    | 16,600                                   | 750                | 0.03~0.05                       | 0.063                            | 13,800  | 560                | 0.027~0.045                     | 0.063                            | 11,200   | 390                | 0.021~0.035                     | 0.063                            |
|               |                       | 12                    | 14,800                                   | 630                | 0.023~0.038                     | 0.037                            | 12,400  | 470                | 0.02~0.034                      | 0.037                            | 10,200   | 340                | 0.016~0.026                     | 0.037                            |
|               |                       | 14                    | 13,400                                   | 550                | 0.017~0.029                     | 0.023                            | 11,200  | 410                | 0.016~0.026                     | 0.023                            | 9,500  | 300                | 0.012~0.02                      | 0.023                            |
|               |                       | 16                    | 12,300                                   | 480                | 0.013~0.022                     | 0.015                            | 10,300  | 360                | 0.012~0.02                      | 0.015                            | 8,900  | 270                | 0.009~0.016                     | 0.015                            |
|               |                       | 18                    | 11,500                                   | 420                | 0.011~0.018                     | 0.011                            | 9,600   | 310                | 0.01~0.016                      | 0.011                            | 8,400  | 240                | 0.007~0.012                     | 0.011                            |
|               |                       | 20                    | 10,700                                   | 370                | 0.009~0.014                     | 0.008                            | 9,000   | 280                | 0.008~0.013                     | 0.008                            | 7,900  | 220                | 0.006~0.01                      | 0.008                            |
|               |                       | 25                    | 9,300                                    | 270                | 0.005~0.009                     | 0.004                            | 7,800   | 200                | 0.005~0.008                     | 0.004                            | 7,100  | 160                | 0.004~0.006                     | 0.004                            |
|               |                       | 30                    | 8,300                                    | 200                | 0.004~0.007                     | 0.002                            | 7,000   | 150                | 0.004~0.006                     | 0.002                            | 6,500  | 120                | 0.003~0.005                     | 0.002                            |
|               |                       | 35                    | 7,600                                    | 140                | 0.003~0.004                     | 0.001                            | 6,400   | 110                | 0.003~0.004                     | 0.001                            | 6,000  | 90                 | 0.002~0.003                     | 0.001                            |
|               |                       | 40                    | 7,000                                    | 90                 | 0.002~0.003                     | 0.001                            | 5,800   | 70                 | 0.002~0.003                     | 0.001                            | 5,600  | 60                 | 0.002~0.002                     | 0.001                            |
| 45            | 6,500                 | 60                    | 0.002~0.003                              | 0.001              | 5,400                           | 50                               | 0.002~0.002                                   | 0.001              | 5,300                           | 40                               | 0.001~0.002  | 0.001              |                                 |                                  |
| 2016          | 1.6                   | 6                     | 22,200                                   | 1,170              | 0.065~0.108                     | 0.379                            | 18,500  | 870                | 0.058~0.097                     | 0.379                            | 13,800   | 570                | 0.045~0.076                     | 0.379                            |
|               |                       | 8                     | 18,500                                   | 940                | 0.047~0.079                     | 0.16                             | 15,500  | 700                | 0.042~0.071                     | 0.16                             | 12,000   | 480                | 0.033~0.055                     | 0.16                             |
|               |                       | 10                    | 16,100                                   | 780                | 0.035~0.058                     | 0.082                            | 13,500  | 580                | 0.032~0.053                     | 0.082                            | 10,800   | 410                | 0.025~0.041                     | 0.082                            |
|               |                       | 12                    | 14,400                                   | 670                | 0.027~0.044                     | 0.047                            | 12,000  | 500                | 0.024~0.04                      | 0.047                            | 9,800  | 360                | 0.019~0.031                     | 0.047                            |
|               |                       | 14                    | 13,000                                   | 580                | 0.02~0.034                      | 0.03                             | 10,900  | 430                | 0.018~0.031                     | 0.03                             | 9,100  | 320                | 0.014~0.024                     | 0.03                             |
|               |                       | 16                    | 12,000                                   | 510                | 0.016~0.027                     | 0.02                             | 10,000  | 380                | 0.014~0.024                     | 0.02                             | 8,500  | 280                | 0.011~0.019                     | 0.02                             |
|               |                       | 18                    | 11,100                                   | 450                | 0.013~0.022                     | 0.014                            | 9,300   | 340                | 0.012~0.019                     | 0.014                            | 8,000  | 260                | 0.009~0.015                     | 0.014                            |
|               |                       | 20                    | 10,400                                   | 400                | 0.011~0.018                     | 0.01                             | 8,700   | 300                | 0.01~0.016                      | 0.01                             | 7,600  | 230                | 0.007~0.012                     | 0.01                             |
|               |                       | 26                    | 8,800                                    | 280                | 0.007~0.011                     | 0.005                            | 7,400   | 210                | 0.006~0.01                      | 0.005                            | 6,700  | 170                | 0.005~0.008                     | 0.005                            |
| 2018          | 1.8                   | 6                     | 21,000                                   | 1,270              | 0.061~0.102                     | 0.608                            | 17,800  | 950                | 0.055~0.092                     | 0.608                            | 12,800   | 600                | 0.043~0.071                     | 0.608                            |
|               |                       | 8                     | 17,700                                   | 1,020              | 0.05~0.083                      | 0.256                            | 14,900  | 760                | 0.045~0.075                     | 0.256                            | 11,100   | 500                | 0.035~0.058                     | 0.256                            |
|               |                       | 10                    | 15,400                                   | 860                | 0.041~0.068                     | 0.131                            | 12,900  | 640                | 0.037~0.061                     | 0.131                            | 9,900  | 430                | 0.029~0.048                     | 0.131                            |
|               |                       | 12                    | 13,800                                   | 740                | 0.033~0.055                     | 0.076                            | 11,500  | 550                | 0.03~0.05                       | 0.076                            | 9,100  | 380                | 0.023~0.039                     | 0.076                            |
|               |                       | 14                    | 12,500                                   | 640                | 0.027~0.045                     | 0.048                            | 10,500  | 480                | 0.024~0.041                     | 0.048                            | 8,400  | 340                | 0.019~0.032                     | 0.048                            |
|               |                       | 16                    | 11,500                                   | 570                | 0.022~0.037                     | 0.032                            | 9,600   | 420                | 0.02~0.033                      | 0.032                            | 7,800  | 300                | 0.016~0.026                     | 0.032                            |
|               |                       | 18                    | 10,700                                   | 500                | 0.018~0.03                      | 0.023                            | 8,900   | 380                | 0.016~0.027                     | 0.023                            | 7,400  | 280                | 0.013~0.021                     | 0.023                            |
|               |                       | 20                    | 10,000                                   | 450                | 0.015~0.025                     | 0.016                            | 8,400   | 340                | 0.013~0.022                     | 0.016                            | 7,000  | 250                | 0.01~0.017                      | 0.016                            |
|               |                       | 25                    | 8,700                                    | 350                | 0.009~0.015                     | 0.008                            | 7,300   | 260                | 0.008~0.014                     | 0.008                            | 6,300  | 200                | 0.006~0.011                     | 0.008                            |
| 2020          | 2                     | 6                     | 20,300                                   | 1,350              | 0.064~0.107                     | 0.926                            | 17,400  | 1,030              | 0.058~0.097                     | 0.926                            | 12,500   | 650                | 0.045~0.075                     | 0.926                            |
|               |                       | 8                     | 17,000                                   | 1,090              | 0.054~0.089                     | 0.391                            | 14,500  | 830                | 0.048~0.081                     | 0.391                            | 10,800   | 540                | 0.038~0.063                     | 0.391                            |
|               |                       | 10                    | 14,800                                   | 920                | 0.045~0.075                     | 0.2                              | 12,600  | 700                | 0.04~0.067                      | 0.2                              | 9,700  | 470                | 0.031~0.052                     | 0.2                              |
|               |                       | 12                    | 13,200                                   | 790                | 0.037~0.062                     | 0.116                            | 11,200  | 600                | 0.034~0.056                     | 0.116                            | 8,900  | 420                | 0.026~0.044                     | 0.116                            |
|               |                       | 14                    | 12,000                                   | 700                | 0.031~0.052                     | 0.073                            | 10,200  | 530                | 0.028~0.047                     | 0.073                            | 8,200  | 370                | 0.022~0.036                     | 0.073                            |
|               |                       | 16                    | 11,100                                   | 620                | 0.026~0.044                     | 0.049                            | 9,400   | 470                | 0.024~0.039                     | 0.049                            | 7,700  | 340                | 0.018~0.03                      | 0.049                            |
|               |                       | 18                    | 10,300                                   | 550                | 0.022~0.036                     | 0.034                            | 8,700   | 420                | 0.02~0.033                      | 0.034                            | 7,200  | 310                | 0.015~0.026                     | 0.034                            |
|               |                       | 20                    | 9,600                                    | 500                | 0.018~0.031                     | 0.025                            | 8,100   | 380                | 0.016~0.027                     | 0.025                            | 6,900  | 280                | 0.013~0.021                     | 0.025                            |
|               |                       | 25                    | 8,400                                    | 390                | 0.012~0.02                      | 0.013                            | 7,100   | 290                | 0.011~0.018                     | 0.013                            | 6,200  | 230                | 0.008~0.014                     | 0.013                            |
|               |                       | 30                    | 7,500                                    | 310                | 0.008~0.013                     | 0.007                            | 6,300   | 230                | 0.007~0.012                     | 0.007                            | 5,600  | 180                | 0.005~0.009                     | 0.007                            |
|               |                       | 35                    | 6,800                                    | 250                | 0.005~0.008                     | 0.005                            | 5,700   | 190                | 0.005~0.008                     | 0.005                            | 5,200  | 150                | 0.004~0.006                     | 0.005                            |
|               |                       | 40                    | 6,300                                    | 200                | 0.003~0.006                     | 0.003                            | 5,200   | 150                | 0.003~0.005                     | 0.003                            | 4,900  | 120                | 0.002~0.004                     | 0.003                            |
|               |                       | 50                    | 5,400                                    | 110                | 0.003~0.004                     | 0.002                            | 4,500   | 90                 | 0.002~0.002                     | 0.002                            | 4,400  | 70                 | 0.002~0.002                     | 0.002                            |
| 60            | 4,900                 | 50                    | 0.002~0.003                              | 0.002              | 4,000                           | 40                               | 0.002~0.002                                   | 0.002              | 4,000                           | 30                               | 0.002~0.002  | 0.002              |                                 |                                  |



## Milling Conditions for HLS (2 Flutes)

| WORK MATERIAL |                       |                       | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKH<br>(55~60HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2015          | 1.5                   | 4                     | 13,000                                     | 440                | 0.036~0.06                      | 0.462                            | 9,600                                      | 95                 | 0.02 ~0.036                     | 0.462                            |
|               |                       | 6                     | 11,500                                     | 380                | 0.028~0.047                     | 0.293                            | 9,600                                      | 60                 | 0.016~0.028                     | 0.293                            |
|               |                       | 8                     | 10,000                                     | 320                | 0.02 ~0.034                     | 0.124                            | 9,600                                      | 25                 | 0.012~0.02                      | 0.124                            |
|               |                       | 10                    | 8,900                                      | 270                | 0.015~0.025                     | 0.063                            | 9,600                                      | 13                 | 0.009~0.015                     | 0.063                            |
|               |                       | 12                    | 8,200                                      | 240                | 0.011~0.019                     | 0.037                            | —  | —                  | — ~ —                           | 0.037                            |
|               |                       | 14                    | 7,600                                      | 210                | 0.009~0.014                     | 0.023                            | —  | —                  | — ~ —                           | 0.023                            |
|               |                       | 16                    | 7,100                                      | 190                | 0.007~0.011                     | 0.015                            | —  | —                  | — ~ —                           | 0.015                            |
|               |                       | 18                    | 6,700                                      | 170                | 0.005~0.009                     | 0.011                            | —  | —                  | — ~ —                           | 0.011                            |
|               |                       | 20                    | 6,300                                      | 150                | 0.004~0.007                     | 0.008                            | —  | —                  | — ~ —                           | 0.008                            |
|               |                       | 25                    | 5,700                                      | 110                | 0.003~0.005                     | 0.004                            | —  | —                  | — ~ —                           | 0.004                            |
|               |                       | 30                    | 5,200                                      | 90                 | 0.002~0.003                     | 0.002                            | —  | —                  | — ~ —                           | 0.002                            |
|               |                       | 35                    | 4,800                                      | 60                 | 0.002~0.002                     | 0.001                            | —  | —                  | — ~ —                           | 0.001                            |
|               |                       | 40                    | 4,500                                      | 40                 | 0.001~0.002                     | 0.001                            | —  | —                  | — ~ —                           | 0.001                            |
|               |                       | 45                    | 4,300                                      | 30                 | 0.001~0.001                     | 0.001                            | —  | —                  | — ~ —                           | 0.001                            |
| 2016          | 1.6                   | 6                     | 11,100                                     | 400                | 0.032~0.054                     | 0.379                            | 9,600                                      | 73                 | 0.019~0.032                     | 0.379                            |
|               |                       | 8                     | 9,600                                      | 330                | 0.024~0.039                     | 0.16                             | 9,600                                      | 31                 | 0.014~0.023                     | 0.16                             |
|               |                       | 10                    | 8,600                                      | 280                | 0.018~0.029                     | 0.082                            | 9,600                                      | 15                 | 0.01 ~0.017                     | 0.082                            |
|               |                       | 12                    | 7,900                                      | 250                | 0.013~0.022                     | 0.047                            | —  | —                  | — ~ —                           | 0.047                            |
|               |                       | 14                    | 7,300                                      | 220                | 0.01 ~0.017                     | 0.03                             | —  | —                  | — ~ —                           | 0.03                             |
|               |                       | 16                    | 6,800                                      | 200                | 0.008~0.013                     | 0.02                             | —  | —                  | — ~ —                           | 0.02                             |
|               |                       | 18                    | 6,400                                      | 180                | 0.006~0.011                     | 0.014                            | —  | —                  | — ~ —                           | 0.014                            |
|               |                       | 20                    | 6,100                                      | 160                | 0.005~0.009                     | 0.01                             | —  | —                  | — ~ —                           | 0.01                             |
|               |                       | 26                    | 5,300                                      | 120                | 0.003~0.005                     | 0.005                            | —  | —                  | — ~ —                           | 0.005                            |
| 2018          | 1.8                   | 6                     | 10,200                                     | 410                | 0.031~0.051                     | 0.608                            | 9,600                                      | 137                | 0.018~0.031                     | 0.608                            |
|               |                       | 8                     | 8,900                                      | 350                | 0.025~0.042                     | 0.256                            | 9,600                                      | 58                 | 0.015~0.025                     | 0.256                            |
|               |                       | 10                    | 7,900                                      | 300                | 0.02 ~0.034                     | 0.131                            | 9,600                                      | 29                 | 0.012~0.02                      | 0.131                            |
|               |                       | 12                    | 7,200                                      | 260                | 0.017~0.028                     | 0.076                            | 9,600                                      | 17                 | 0.01 ~0.017                     | 0.076                            |
|               |                       | 14                    | 6,700                                      | 230                | 0.014~0.023                     | 0.048                            | 9,600                                      | 10                 | 0.008~0.014                     | 0.048                            |
|               |                       | 16                    | 6,300                                      | 210                | 0.011~0.019                     | 0.032                            | —  | —                  | — ~ —                           | 0.032                            |
|               |                       | 18                    | 5,900                                      | 190                | 0.009~0.015                     | 0.023                            | —  | —                  | — ~ —                           | 0.023                            |
|               |                       | 20                    | 5,600                                      | 170                | 0.007~0.012                     | 0.016                            | —  | —                  | — ~ —                           | 0.016                            |
|               |                       | 25                    | 5,000                                      | 140                | 0.005~0.008                     | 0.008                            | —  | —                  | — ~ —                           | 0.008                            |
| 2020          | 2                     | 6                     | 10,000                                     | 450                | 0.032~0.054                     | 0.926                            | 9,600                                      | 211                | 0.019~0.032                     | 0.926                            |
|               |                       | 8                     | 8,700                                      | 380                | 0.027~0.045                     | 0.391                            | 9,600                                      | 89                 | 0.016~0.027                     | 0.391                            |
|               |                       | 10                    | 7,800                                      | 330                | 0.022~0.037                     | 0.2                              | 9,600                                      | 45                 | 0.013~0.022                     | 0.2                              |
|               |                       | 12                    | 7,100                                      | 290                | 0.019~0.031                     | 0.116                            | 9,600                                      | 28                 | 0.011~0.019                     | 0.116                            |
|               |                       | 14                    | 6,600                                      | 260                | 0.016~0.026                     | 0.073                            | 9,600                                      | 16                 | 0.009~0.016                     | 0.073                            |
|               |                       | 16                    | 6,100                                      | 230                | 0.013~0.022                     | 0.049                            | 9,600                                      | 11                 | 0.007~0.013                     | 0.049                            |
|               |                       | 18                    | 5,800                                      | 210                | 0.011~0.018                     | 0.034                            | —  | —                  | — ~ —                           | 0.034                            |
|               |                       | 20                    | 5,500                                      | 190                | 0.009~0.015                     | 0.025                            | —  | —                  | — ~ —                           | 0.025                            |
|               |                       | 25                    | 4,900                                      | 160                | 0.006~0.01                      | 0.013                            | —  | —                  | — ~ —                           | 0.013                            |
|               |                       | 30                    | 4,500                                      | 130                | 0.004~0.006                     | 0.007                            | —  | —                  | — ~ —                           | 0.007                            |
|               |                       | 35                    | 4,200                                      | 100                | 0.003~0.004                     | 0.005                            | —  | —                  | — ~ —                           | 0.005                            |
|               |                       | 40                    | 3,900                                      | 80                 | 0.002~0.003                     | 0.003                            | —  | —                  | — ~ —                           | 0.003                            |
|               |                       | 50                    | 3,500                                      | 50                 | 0.001~0.001                     | 0.002                            | —  | —                  | — ~ —                           | 0.002                            |
|               |                       | 60                    | 3,200                                      | 30                 | 0.001~0.001                     | 0.002                            | —  | —                  | — ~ —                           | 0.002                            |

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius

Taper Neck

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball

Taper Neck

Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral

Spiral  
V Cutter

Drill

Drill

Technical Data

Milling Conditions for HLS (2 Flutes)

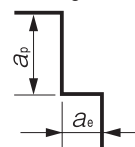
| WORK MATERIAL |                       |                       | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD(30~45HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                           | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2025          | 2.5                   | 8                     | 15,000                                   | 1,340              | 0.077~0.129                     | 0.954                            | 12,800  | 1,020              | 0.069~0.116                     | 0.954                            | 9,600  | 670                | 0.054~0.09                      | 0.954                            |
|               |                       | 10                    | 13,100                                   | 1,140              | 0.068~0.113                     | 0.488                            | 11,100  | 860                | 0.061~0.102                     | 0.488                            | 8,600  | 590                | 0.048~0.079                     | 0.488                            |
|               |                       | 12                    | 11,800                                   | 1,000              | 0.06~0.099                      | 0.283                            | 10,000  | 750                | 0.054~0.089                     | 0.283                            | 7,900  | 520                | 0.042~0.07                      | 0.283                            |
|               |                       | 14                    | 10,700                                   | 880                | 0.052~0.087                     | 0.178                            | 9,100   | 660                | 0.047~0.078                     | 0.178                            | 7,300  | 470                | 0.036~0.061                     | 0.178                            |
|               |                       | 16                    | 9,900                                    | 790                | 0.045~0.075                     | 0.119                            | 8,400   | 590                | 0.04~0.067                      | 0.119                            | 6,800  | 430                | 0.031~0.052                     | 0.119                            |
|               |                       | 18                    | 9,200                                    | 710                | 0.039~0.064                     | 0.084                            | 7,800   | 540                | 0.035~0.058                     | 0.084                            | 6,500  | 390                | 0.027~0.045                     | 0.084                            |
|               |                       | 20                    | 8,700                                    | 650                | 0.033~0.055                     | 0.061                            | 7,300   | 490                | 0.03~0.05                       | 0.061                            | 6,100  | 360                | 0.023~0.039                     | 0.061                            |
|               |                       | 25                    | 7,600                                    | 520                | 0.022~0.036                     | 0.031                            | 6,400   | 390                | 0.019~0.032                     | 0.031                            | 5,500  | 300                | 0.015~0.025                     | 0.031                            |
|               |                       | 30                    | 6,800                                    | 430                | 0.014~0.023                     | 0.018                            | 5,700   | 320                | 0.012~0.02                      | 0.018                            | 5,000  | 250                | 0.01~0.016                      | 0.018                            |
|               |                       | 40                    | 5,700                                    | 290                | 0.005~0.008                     | 0.008                            | 4,800   | 220                | 0.004~0.007                     | 0.008                            | 4,400  | 170                | 0.003~0.006                     | 0.008                            |
|               |                       | 50                    | 5,000                                    | 190                | 0.003~0.004                     | 0.004                            | 4,200   | 140                | 0.002~0.004                     | 0.004                            | 3,900  | 120                | 0.002~0.003                     | 0.004                            |
|               |                       | 2030                  | 3  | 8                  | 13,200                          | 1,470                            | 0.103~0.172                                   | 1.978              | 10,900                          | 1,080                            | 0.093~0.155  | 1.978              | 8,000                           | 700                              |
| 10            | 11,600                |                       |  | 1,270              | 0.092~0.153                     | 1.013                            | 9,600   | 930                | 0.083~0.138                     | 1.013                            | 7,200  | 620                | 0.064~0.107                     | 1.013                            |
| 12            | 10,500                |                       |  | 1,110              | 0.081~0.136                     | 0.586                            | 8,700   | 830                | 0.073~0.122                     | 0.586                            | 6,700  | 560                | 0.057~0.095                     | 0.586                            |
| 14            | 9,600                 |                       |  | 1,000              | 0.072~0.12                      | 0.369                            | 8,000   | 740                | 0.065~0.108                     | 0.369                            | 6,200  | 510                | 0.051~0.084                     | 0.369                            |
| 16            | 8,900                 |                       |  | 900                | 0.064~0.107                     | 0.247                            | 7,400   | 670                | 0.058~0.096                     | 0.247                            | 5,900  | 470                | 0.045~0.075                     | 0.247                            |
| 18            | 8,300                 |                       |  | 820                | 0.057~0.094                     | 0.174                            | 7,000   | 610                | 0.051~0.085                     | 0.174                            | 5,600  | 430                | 0.04~0.066                      | 0.174                            |
| 20            | 7,800                 |                       |  | 750                | 0.05~0.083                      | 0.127                            | 6,600   | 560                | 0.045~0.075                     | 0.127                            | 5,300  | 400                | 0.035~0.058                     | 0.127                            |
| 25            | 6,900                 |                       |  | 620                | 0.036~0.06                      | 0.065                            | 5,800   | 460                | 0.032~0.054                     | 0.065                            | 4,800  | 340                | 0.025~0.042                     | 0.065                            |
| 30            | 6,200                 |                       |  | 520                | 0.026~0.043                     | 0.038                            | 5,200   | 390                | 0.023~0.039                     | 0.038                            | 4,500  | 290                | 0.018~0.03                      | 0.038                            |
| 35            | 5,700                 |                       |  | 440                | 0.018~0.031                     | 0.024                            | 4,800   | 330                | 0.016~0.027                     | 0.024                            | 4,200  | 250                | 0.013~0.021                     | 0.024                            |
| 40            | 5,300                 |                       |  | 370                | 0.013~0.021                     | 0.016                            | 4,500   | 280                | 0.012~0.019                     | 0.016                            | 3,900  | 220                | 0.009~0.015                     | 0.016                            |
| 50            | 4,700                 |                       |  | 270                | 0.006~0.01                      | 0.008                            | 3,900   | 200                | 0.005~0.009                     | 0.008                            | 3,600  | 160                | 0.004~0.007                     | 0.008                            |
| 2040          | 4                     | 12                    | 8,500                                    | 1,280              | 0.112~0.187                     | 1.852                            | 7,100   | 950                | 0.101~0.168                     | 1.852                            | 5,100  | 600                | 0.078~0.131                     | 1.852                            |
|               |                       | 16                    | 7,200                                    | 1,050              | 0.093~0.155                     | 0.781                            | 6,000   | 770                | 0.084~0.139                     | 0.781                            | 4,400  | 510                | 0.065~0.108                     | 0.781                            |
|               |                       | 20                    | 6,300                                    | 880                | 0.077~0.128                     | 0.4                              | 5,200   | 650                | 0.069~0.115                     | 0.4                              | 4,000  | 440                | 0.054~0.09                      | 0.4                              |
|               |                       | 25                    | 5,600                                    | 750                | 0.061~0.101                     | 0.205                            | 4,600   | 540                | 0.055~0.091                     | 0.205                            | 3,600  | 380                | 0.042~0.071                     | 0.205                            |
|               |                       | 30                    | 5,000                                    | 630                | 0.048~0.08                      | 0.119                            | 4,100   | 460                | 0.043~0.072                     | 0.119                            | 3,300  | 330                | 0.033~0.056                     | 0.119                            |
|               |                       | 35                    | 4,600                                    | 540                | 0.038~0.063                     | 0.075                            | 3,800   | 400                | 0.034~0.057                     | 0.075                            | 3,100  | 290                | 0.026~0.044                     | 0.075                            |
|               |                       | 40                    | 4,200                                    | 470                | 0.03~0.049                      | 0.05                             | 3,500   | 350                | 0.027~0.044                     | 0.05                             | 2,900  | 250                | 0.021~0.035                     | 0.05                             |
|               |                       | 45                    | 3,900                                    | 410                | 0.023~0.039                     | 0.035                            | 3,300   | 300                | 0.021~0.035                     | 0.035                            | 2,700  | 230                | 0.016~0.027                     | 0.035                            |
|               |                       | 50                    | 3,700                                    | 360                | 0.018~0.031                     | 0.026                            | 3,100   | 270                | 0.016~0.027                     | 0.026                            | 2,600  | 200                | 0.013~0.021                     | 0.026                            |
|               |                       | 60                    | 3,300                                    | 280                | 0.011~0.019                     | 0.015                            | 2,800   | 210                | 0.01~0.017                      | 0.015                            | 2,400  | 160                | 0.008~0.013                     | 0.015                            |
|               |                       | 16                    | 6,000                                    | 1,140              | 0.127~0.212                     | 1.907                            | 5,100   | 860                | 0.114~0.191                     | 1.907                            | 3,500  | 520                | 0.089~0.148                     | 1.907                            |
|               |                       | 20                    | 5,300                                    | 980                | 0.121~0.202                     | 0.977                            | 4,400   | 730                | 0.109~0.182                     | 0.977                            | 3,100  | 440                | 0.085~0.142                     | 0.977                            |
| 25            | 4,600                 | 820                   | 0.109~0.182                              | 0.5                | 3,800                           | 600                              | 0.099~0.164                                   | 0.5                | 2,800                           | 390                              | 0.077~0.128  | 0.5                |                                 |                                  |
| 30            | 4,200                 | 710                   | 0.094~0.157                              | 0.289              | 3,400                           | 510                              | 0.085~0.141                                   | 0.289              | 2,500                           | 340                              | 0.066~0.11   | 0.289              |                                 |                                  |
| 35            | 3,800                 | 620                   | 0.077~0.128                              | 0.182              | 3,100                           | 450                              | 0.069~0.115                                   | 0.182              | 2,300                           | 300                              | 0.054~0.09   | 0.182              |                                 |                                  |
| 40            | 3,500                 | 540                   | 0.06~0.099                               | 0.122              | 2,800                           | 390                              | 0.054~0.089                                   | 0.122              | 2,200                           | 270                              | 0.042~0.07   | 0.122              |                                 |                                  |
| 50            | 3,100                 | 430                   | 0.031~0.052                              | 0.063              | 2,400                           | 300                              | 0.028~0.047                                   | 0.063              | 1,900                           | 210                              | 0.022~0.036  | 0.063              |                                 |                                  |
| 60            | 2,800                 | 350                   | 0.02~0.035                               | 0.035              | 2,100                           | 240                              | 0.02~0.033                                    | 0.035              | 1,800                           | 170                              | 0.019~0.031  | 0.035              |                                 |                                  |
| 2060          | 6                     | 20                    | 4,200                                    | 960                | 0.126~0.211                     | 2.025                            | 3,800   | 780                | 0.114~0.19                      | 2.025                            | 2,600  | 470                | 0.088~0.147                     | 2.025                            |
|               |                       | 30                    | 3,400                                    | 730                | 0.109~0.182                     | 0.6                              | 2,800   | 540                | 0.099~0.164                     | 0.6                              | 2,000  | 340                | 0.077~0.128                     | 0.6                              |
|               |                       | 40                    | 3,000                                    | 600                | 0.083~0.138                     | 0.253                            | 2,300   | 410                | 0.074~0.124                     | 0.253                            | 1,700  | 260                | 0.058~0.096                     | 0.253                            |
|               |                       | 50                    | 2,600                                    | 480                | 0.054~0.09                      | 0.13                             | 1,900   | 310                | 0.049~0.081                     | 0.13                             | 1,500  | 220                | 0.038~0.063                     | 0.13                             |
| 60            | 2,400                 | 410                   | 0.031~0.052                              | 0.075              | 1,700                           | 260                              | 0.028~0.047                                   | 0.075              | 1,300                           | 170                              | 0.022~0.036  | 0.075              |                                 |                                  |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

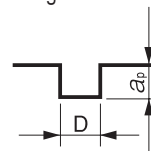
## Milling Conditions for HLS (2 Flutes)

| WORK MATERIAL |                       |                       | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                           |                            | HARDENED STEELS<br>SKD / SKH<br>(55~60HRC) |                    |                           |                            |
|---------------|-----------------------|-----------------------|--|--------------------|---------------------------|----------------------------|--|--------------------|---------------------------|----------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 2025          | 2.5                   | 8                     | 7,700                                      | 460                | 0.039~0.064               | 0.954                      | 9,600                                      | 227                | 0.023~0.038               | 0.954                      |
|               |                       | 10                    | 6,900                                      | 400                | 0.034~0.057               | 0.488                      | 9,600                                      | 116                | 0.02~0.034                | 0.488                      |
|               |                       | 12                    | 6,300                                      | 360                | 0.03~0.05                 | 0.283                      | 9,600                                      | 67                 | 0.018~0.03                | 0.283                      |
|               |                       | 14                    | 5,800                                      | 320                | 0.026~0.043               | 0.178                      | 9,600                                      | 42                 | 0.015~0.026               | 0.178                      |
|               |                       | 16                    | 5,500                                      | 290                | 0.022~0.037               | 0.119                      | 9,600                                      | 28                 | 0.013~0.022               | 0.119                      |
|               |                       | 18                    | 5,200                                      | 270                | 0.019~0.032               | 0.084                      | 9,600                                      | 20                 | 0.011~0.019               | 0.084                      |
|               |                       | 20                    | 4,900                                      | 250                | 0.017~0.028               | 0.061                      | 9,600                                      | 14                 | 0.01~0.017                | 0.061                      |
|               |                       | 25                    | 4,400                                      | 210                | 0.011~0.018               | 0.031                      | —  | —                  | —~—                       | 0.031                      |
|               |                       | 30                    | 4,000                                      | 170                | 0.007~0.011               | 0.018                      | —  | —                  | —~—                       | 0.018                      |
|               |                       | 40                    | 3,500                                      | 120                | 0.002~0.004               | 0.008                      | —  | —                  | —~—                       | 0.008                      |
|               |                       | 50                    | 3,100                                      | 80                 | 0.002~0.002               | 0.004                      | —  | —                  | —~—                       | 0.004                      |
| 2030          | 3                     | 8                     | 6,400                                      | 480                | 0.052~0.086               | 1.978                      | 8,000                                      | 435                | 0.031~0.052               | 1.978                      |
|               |                       | 10                    | 5,800                                      | 430                | 0.046~0.076               | 1.013                      | 8,000                                      | 222                | 0.027~0.046               | 1.013                      |
|               |                       | 12                    | 5,300                                      | 380                | 0.041~0.068               | 0.586                      | 8,000                                      | 128                | 0.024~0.041               | 0.586                      |
|               |                       | 14                    | 5,000                                      | 350                | 0.036~0.06                | 0.369                      | 8,000                                      | 81                 | 0.021~0.036               | 0.369                      |
|               |                       | 16                    | 4,700                                      | 320                | 0.032~0.053               | 0.247                      | 8,000                                      | 54                 | 0.019~0.032               | 0.247                      |
|               |                       | 18                    | 4,500                                      | 300                | 0.028~0.047               | 0.174                      | 8,000                                      | 38                 | 0.016~0.028               | 0.174                      |
|               |                       | 20                    | 4,300                                      | 280                | 0.025~0.042               | 0.127                      | 8,000                                      | 27                 | 0.015~0.025               | 0.127                      |
|               |                       | 25                    | 3,900                                      | 230                | 0.018~0.03                | 0.065                      | 8,000                                      | 14                 | 0.01~0.018                | 0.065                      |
|               |                       | 30                    | 3,600                                      | 200                | 0.013~0.022               | 0.038                      | 8,000                                      | 10                 | 0.007~0.013               | 0.038                      |
|               |                       | 35                    | 3,300                                      | 170                | 0.009~0.015               | 0.024                      | —  | —                  | —~—                       | 0.024                      |
|               |                       | 40                    | 3,100                                      | 150                | 0.006~0.011               | 0.016                      | —  | —                  | —~—                       | 0.016                      |
|               |                       | 50                    | 2,800                                      | 110                | 0.003~0.005               | 0.008                      | —  | —                  | —~—                       | 0.008                      |
| 2040          | 4                     | 12                    | 4,100                                      | 410                | 0.056~0.093               | 1.852                      | 6,000                                      | 388                | 0.033~0.056               | 1.852                      |
|               |                       | 16                    | 3,600                                      | 350                | 0.046~0.077               | 0.781                      | 6,000                                      | 164                | 0.027~0.046               | 0.781                      |
|               |                       | 20                    | 3,200                                      | 300                | 0.038~0.064               | 0.4                        | 6,000                                      | 84                 | 0.022~0.038               | 0.4                        |
|               |                       | 25                    | 2,900                                      | 260                | 0.03~0.051                | 0.205                      | 6,000                                      | 43                 | 0.018~0.031               | 0.205                      |
|               |                       | 30                    | 2,600                                      | 230                | 0.024~0.04                | 0.119                      | 6,000                                      | 24                 | 0.014~0.024               | 0.119                      |
|               |                       | 35                    | 2,500                                      | 200                | 0.019~0.031               | 0.075                      | 6,000                                      | 15                 | 0.011~0.019               | 0.075                      |
|               |                       | 40                    | 2,300                                      | 180                | 0.015~0.025               | 0.05                       | 6,000                                      | 10                 | 0.009~0.015               | 0.05                       |
|               |                       | 45                    | 2,200                                      | 160                | 0.012~0.019               | 0.035                      | —  | —                  | —~—                       | 0.035                      |
|               |                       | 50                    | 2,100                                      | 140                | 0.009~0.015               | 0.026                      | —  | —                  | —~—                       | 0.026                      |
|               |                       | 60                    | 1,900                                      | 110                | 0.006~0.009               | 0.015                      | —  | —                  | —~—                       | 0.015                      |
| 2050          | 5                     | 16                    | 2,800                                      | 360                | 0.064~0.106               | 1.907                      | 4,800                                      | 457                | 0.038~0.064               | 1.907                      |
|               |                       | 20                    | 2,500                                      | 310                | 0.061~0.101               | 0.977                      | 4,800                                      | 234                | 0.036~0.061               | 0.977                      |
|               |                       | 25                    | 2,200                                      | 270                | 0.055~0.091               | 0.5                        | 4,800                                      | 120                | 0.033~0.055               | 0.5                        |
|               |                       | 30                    | 2,000                                      | 230                | 0.047~0.078               | 0.289                      | 4,800                                      | 69                 | 0.028~0.047               | 0.289                      |
|               |                       | 35                    | 1,900                                      | 210                | 0.038~0.064               | 0.182                      | 4,800                                      | 43                 | 0.022~0.038               | 0.182                      |
|               |                       | 40                    | 1,700                                      | 180                | 0.03~0.05                 | 0.122                      | 4,800                                      | 29                 | 0.018~0.03                | 0.122                      |
|               |                       | 50                    | 1,500                                      | 150                | 0.016~0.026               | 0.063                      | 4,800                                      | 15                 | 0.009~0.016               | 0.063                      |
| 60            | 1,400                 | 120                   | 0.007~0.011                                | 0.035              | 4,800                     | 10                         | 0.004~0.007                                | 0.035              |                           |                            |
| 2060          | 6                     | 20                    | 2,100                                      | 330                | 0.063~0.105               | 2.025                      | 4,000                                      | 607                | 0.037~0.063               | 2.025                      |
|               |                       | 30                    | 1,600                                      | 240                | 0.055~0.091               | 0.6                        | 4,000                                      | 180                | 0.033~0.055               | 0.6                        |
|               |                       | 40                    | 1,300                                      | 170                | 0.041~0.069               | 0.253                      | 4,000                                      | 75                 | 0.024~0.041               | 0.253                      |
|               |                       | 50                    | 1,200                                      | 160                | 0.027~0.045               | 0.13                       | 4,000                                      | 38                 | 0.016~0.027               | 0.13                       |
|               |                       | 60                    | 1,000                                      | 120                | 0.016~0.026               | 0.075                      | 4,000                                      | 22                 | 0.009~0.016               | 0.075                      |

Side Milling



Slotting



D : Outside Diameter (mm)

## Note:

- Recommend using a non-contact measuring device to avoid damaging the precision tip point.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Every coolant offers stable milling.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend wet coolant for Copper.

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.1 \sim \phi 6$

# C-CER



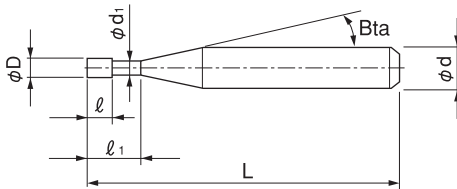
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ○      |        |        |        | ○         |                 |          | ●      |          |                       | ○               | ○                     |                  |                                       |

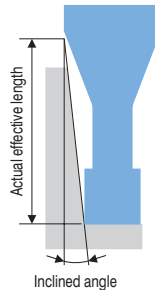
## Features

Long neck square end mill with a positive rake angle.

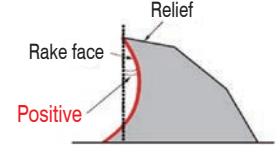
Best suited for Raw materials, Copper, SUS and materials 55HRC and below.



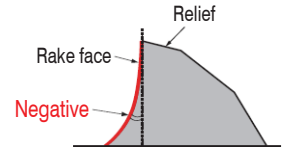
The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



## C-CER Cutting edge



## HLS Cutting edge



Total 148 models

Unit (mm)

| Model Number     | Outside Diameter $\phi D$ | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |      |        |      |      |
|------------------|---------------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|------|--------|------|------|
|                  |                           |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°   | 1° 30' | 2°   | 3°   |
| C-CER 2001-0.3   | 0.1                       | 0.3                    | 0.1               | 0.088                    | 11°                   | 45               | 4                       | 11,160                   | 0.32                                | 0.35 | 0.38   | 0.40 | 0.47 |
| C-CER 2001-0.5   |                           | 0.5                    |                   |                          |                       |                  |                         |                          |                                     |      |        |      |      |
| C-CER 2001-0.75  |                           | 0.75                   |                   |                          |                       |                  |                         |                          |                                     |      |        |      |      |
| C-CER 2001-1     |                           | 1                      |                   |                          |                       |                  |                         |                          |                                     |      |        |      |      |
| C-CER 20015-0.5  | 0.15                      | 0.5                    | 0.15              | 0.128                    | 11°                   | 45               | 4                       | 11,400                   | 0.57                                | 0.61 | 0.65   | 0.69 | 0.79 |
| C-CER 20015-0.75 |                           | 0.75                   |                   |                          |                       |                  |                         |                          |                                     |      |        |      |      |
| C-CER 20015-1    |                           | 1                      |                   |                          |                       |                  |                         |                          |                                     |      |        |      |      |
| C-CER 2002-0.5   |                           | 0.5                    |                   |                          |                       |                  |                         |                          |                                     |      |        |      |      |
| C-CER 2002-1     | 0.2                       | 1                      | 0.3               | 0.18                     | 16°                   | 45               | 4                       | 9,360                    | 1.18                                | 1.25 | 1.31   | 1.36 | 1.45 |
| C-CER 2002-1.5   |                           | 1.5                    |                   |                          |                       |                  |                         |                          |                                     |      |        |      |      |
| C-CER 2002-2     |                           | 2                      |                   |                          |                       |                  |                         |                          |                                     |      |        |      |      |
| C-CER 2002-3     |                           | 3                      |                   |                          |                       |                  |                         |                          |                                     |      |        |      |      |
| C-CER 2003-1     | 0.3                       | 1                      | 0.4               | 0.28                     | 16°                   | 45               | 4                       | 7,560                    | 1.22                                | 1.30 | 1.37   | 1.43 | 1.55 |
| C-CER 2003-1.5   |                           | 1.5                    |                   |                          |                       |                  |                         |                          |                                     |      |        |      |      |
| C-CER 2003-2     |                           | 2                      |                   |                          |                       |                  |                         |                          |                                     |      |        |      |      |
| C-CER 2003-3     |                           | 3                      |                   |                          |                       |                  |                         |                          |                                     |      |        |      |      |

Unit (mm)

| Model Number  | Outside Diameter $\phi D$ | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |        |       |                 |
|---------------|---------------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|--------|-------|-----------------|
|               |                           |                        |                   |                          |                       |                  |                         |                          | 30'                                 | 1°    | 1° 30' | 2°    | 3°              |
| C-CER 2004-2  | 0.4                       | 2                      | 0.6               | 0.38                     | 16°                   | 45               | 4                       | 6,700                    | 2.31                                | 2.47  | 2.60   | 2.71  | 2.91            |
| C-CER 2004-3  |                           | 3                      |                   |                          |                       | 45               | 4                       | 5,520                    | 3.38                                | 3.57  | 3.72   | 3.85  | 4.07            |
| C-CER 2004-4  |                           | 4                      |                   |                          |                       | 45               | 4                       | 5,520                    | 4.44                                | 4.65  | 4.82   | 4.96  | 5.21            |
| C-CER 2004-5  |                           | 5                      |                   |                          |                       | 45               | 4                       | 5,520                    | 5.49                                | 5.73  | 5.91   | 6.06  | 6.33            |
| C-CER 2005-2  | 0.5                       | 2                      | 0.7               | 0.48                     | 16°                   | 45               | 4                       | 3,960                    | 2.37                                | 2.56  | 2.71   | 2.85  | 3.09            |
| C-CER 2005-4  |                           | 4                      |                   |                          |                       | 45               | 4                       | 3,960                    | 4.52                                | 4.77  | 4.97   | 5.14  | 5.44            |
| C-CER 2005-6  |                           | 6                      |                   |                          |                       | 45               | 4                       | 3,960                    | 6.64                                | 6.94  | 7.17   | 7.37  | 7.71            |
| C-CER 2005-8  |                           | 8                      |                   |                          |                       | 45               | 4                       | 6,600                    | 8.74                                | 9.07  | 9.33   | 9.56  | 9.93            |
| C-CER 2006-2  | 0.6                       | 2                      | 0.9               | 0.58                     | 16°                   | 45               | 4                       | 4,200                    | 2.35                                | 2.59  | 2.78   | 2.94  | 3.23            |
| C-CER 2006-4  |                           | 4                      |                   |                          |                       | 45               | 4                       | 4,200                    | 4.54                                | 4.84  | 5.08   | 5.28  | 5.68            |
| C-CER 2006-6  |                           | 6                      |                   |                          |                       | 45               | 4                       | 4,200                    | 6.68                                | 7.03  | 7.30   | 7.56  | 8.13            |
| C-CER 2006-8  |                           | 8                      |                   |                          |                       | 45               | 4                       | 6,840                    | 8.80                                | 9.19  | 9.51   | 9.84  | 10.58           |
| C-CER 2006-10 | 10                        | 45                     | 4                 | 7,920                    | 10.90                 | 11.33            | 11.71                   | 12.11                    | 13.02                               |       |        |       |                 |
| C-CER 2007-2  | 0.7                       | 2                      | 1                 | 0.68                     | 16°                   | 45               | 4                       | 4,800                    | 2.35                                | 2.59  | 2.78   | 2.94  | 3.23            |
| C-CER 2007-3  |                           | 3                      |                   |                          |                       | 45               | 4                       | 4,800                    | 3.46                                | 3.73  | 3.94   | 4.13  | 4.46            |
| C-CER 2007-4  |                           | 4                      |                   |                          |                       | 45               | 4                       | 4,800                    | 4.54                                | 4.84  | 5.08   | 5.28  | 5.68            |
| C-CER 2007-6  |                           | 6                      |                   |                          |                       | 45               | 4                       | 4,800                    | 6.68                                | 7.03  | 7.30   | 7.56  | 8.13            |
| C-CER 2007-8  |                           | 8                      |                   |                          |                       | 45               | 4                       | 7,000                    | 8.80                                | 9.19  | 9.51   | 9.84  | 10.58           |
| C-CER 2007-10 |                           | 10                     |                   |                          |                       | 50               | 4                       | 8,000                    | 10.90                               | 11.33 | 11.71  | 12.11 | 13.02           |
| C-CER 2008-4  | 0.8                       | 4                      | 1.2               | 0.78                     | 16°                   | 45               | 4                       | 4,680                    | 4.54                                | 4.84  | 5.08   | 5.28  | 5.68            |
| C-CER 2008-6  |                           | 6                      |                   |                          |                       | 45               | 4                       | 4,680                    | 6.68                                | 7.03  | 7.30   | 7.56  | 8.13            |
| C-CER 2008-8  |                           | 8                      |                   |                          |                       | 45               | 4                       | 4,680                    | 8.80                                | 9.19  | 9.51   | 9.84  | 10.58           |
| C-CER 2008-10 |                           | 10                     |                   |                          |                       | 50               | 4                       | 6,840                    | 10.90                               | 11.33 | 11.71  | 12.11 | 13.02           |
| C-CER 2008-12 |                           | 12                     |                   |                          |                       | 50               | 4                       | 7,800                    | 12.99                               | 13.45 | 13.91  | 14.39 | 15.47           |
| C-CER 2009-4  |                           | 0.9                    |                   |                          |                       | 4                | 1.3                     | 0.88                     | 16°                                 | 45    | 4      | 5,000 | 4.54            |
| C-CER 2009-6  | 6                         |                        | 45                | 4                        | 5,400                 | 6.68             |                         |                          |                                     | 7.03  | 7.30   | 7.56  | 8.13            |
| C-CER 2009-8  | 8                         |                        | 45                | 4                        | 5,400                 | 8.80             |                         |                          |                                     | 9.19  | 9.51   | 9.84  | 10.58           |
| C-CER 2009-10 | 10                        |                        | 45                | 4                        | 5,400                 | 10.90            |                         |                          |                                     | 11.33 | 11.71  | 12.11 | 13.02           |
| C-CER 2009-15 | 15                        |                        | 50                | 4                        | 8,000                 | 16.11            |                         |                          |                                     | 16.65 | 17.21  | 17.81 | 19.14           |
| C-CER 2010-4  | 1                         |                        | 4                 | 1.5                      | 0.95                  | 16°              |                         |                          |                                     | 45    | 4      | 4,200 | 4.66            |
| C-CER 2010-6  |                           | 6                      | 45                |                          |                       |                  | 4                       | 4,200                    | 6.78                                | 7.10  | 7.36   | 7.62  | 8.19            |
| C-CER 2010-8  |                           | 8                      | 45                |                          |                       |                  | 4                       | 4,200                    | 8.88                                | 9.25  | 9.56   | 9.90  | 10.64           |
| C-CER 2010-10 |                           | 10                     | 45                |                          |                       |                  | 4                       | 4,200                    | 10.97                               | 11.38 | 11.76  | 12.17 | 13.09           |
| C-CER 2010-12 |                           | 12                     | 45                |                          |                       |                  | 4                       | 4,200                    | 13.06                               | 13.51 | 13.97  | 14.45 | 15.53           |
| C-CER 2010-16 |                           | 16                     | 50                |                          |                       |                  | 4                       | 6,840                    | 17.20                               | 17.77 | 18.37  | 19.01 | 20.43           |
| C-CER 2010-20 | 20                        | 55                     | 4                 | 6,840                    | 21.34                 | 22.03            | 22.77                   | 23.56                    | 25.32                               |       |        |       |                 |
| C-CER 2012-6  | 1.2                       | 6                      | 1.8               | 1.14                     | 11°                   | 45               | 4                       | 4,440                    | 6.29                                | 6.61  | 6.95   | 7.34  | 8.25            |
| C-CER 2012-8  |                           | 8                      |                   |                          |                       | 45               | 4                       | 4,440                    | 8.39                                | 8.80  | 9.26   | 9.78  | 10.99           |
| C-CER 2012-10 |                           | 10                     |                   |                          |                       | 45               | 4                       | 4,440                    | 10.48                               | 11.00 | 11.58  | 12.21 | 13.72           |
| C-CER 2012-12 |                           | 12                     |                   |                          |                       | 45               | 4                       | 4,440                    | 12.58                               | 13.20 | 13.89  | 14.65 | 16.46           |
| C-CER 2012-16 |                           | 16                     |                   |                          |                       | 50               | 4                       | 7,080                    | 16.76                               | 17.59 | 18.51  | 19.53 | 21.94           |
| C-CER 2014-6  |                           | 1.4                    |                   |                          |                       | 6                | 2.1                     | 1.34                     | 11°                                 | 45    | 4      | 4,560 | 6.29            |
| C-CER 2014-8  | 8                         |                        | 45                | 4                        | 4,560                 | 8.39             |                         |                          |                                     | 8.80  | 9.26   | 9.78  | 10.99           |
| C-CER 2014-10 | 10                        |                        | 45                | 4                        | 4,560                 | 10.48            |                         |                          |                                     | 11.00 | 11.58  | 12.21 | 13.72           |
| C-CER 2014-12 | 12                        |                        | 45                | 4                        | 4,560                 | 12.58            |                         |                          |                                     | 13.20 | 13.89  | 14.65 | 16.46           |
| C-CER 2014-14 | 14                        |                        | 45                | 4                        | 4,560                 | 14.67            |                         |                          |                                     | 15.40 | 16.20  | 17.09 | 19.20           |
| C-CER 2014-16 | 16                        |                        | 50                | 4                        | 5,280                 | 16.76            |                         |                          |                                     | 17.59 | 18.51  | 19.53 | 21.94           |
| C-CER 2014-22 | 22                        |                        | 55                | 4                        | 7,080                 | 23.05            |                         |                          |                                     | 24.19 | 25.44  | 26.84 | No interference |

3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
BallTaper Neck  
BallTaper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

| Model Number  | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |                 |                 |                 |
|---------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-----------------|-----------------|-----------------|
|               |                           |                           |                      |                          |                       |                  |                         |                          | 30'                                 | 1°    | 1° 30'          | 2°              | 3°              |
| C-CER 2015-6  | 1.5                       | 6                         | 2.3                  | 1.44                     | 11°                   | 45               | 4                       | 4,440                    | 6.29                                | 6.61  | 6.95            | 7.34            | 8.25            |
| C-CER 2015-8  |                           | 8                         |                      |                          |                       | 45               | 4                       | 4,440                    | 8.39                                | 8.80  | 9.26            | 9.78            | 10.99           |
| C-CER 2015-10 |                           | 10                        |                      |                          |                       | 45               | 4                       | 4,440                    | 10.48                               | 11.00 | 11.58           | 12.21           | 13.72           |
| C-CER 2015-12 |                           | 12                        |                      |                          |                       | 45               | 4                       | 4,440                    | 12.58                               | 13.20 | 13.89           | 14.65           | 16.46           |
| C-CER 2015-14 |                           | 14                        |                      |                          |                       | 50               | 4                       | 4,560                    | 14.67                               | 15.40 | 16.20           | 17.09           | 19.20           |
| C-CER 2015-16 |                           | 16                        |                      |                          |                       | 50               | 4                       | 4,560                    | 16.76                               | 17.59 | 18.51           | 19.53           | 21.94           |
| C-CER 2015-18 |                           | 18                        |                      |                          |                       | 55               | 4                       | 4,560                    | 18.86                               | 19.79 | 20.82           | 21.97           | No Interference |
| C-CER 2015-20 |                           | 20                        |                      |                          |                       | 55               | 4                       | 4,560                    | 20.95                               | 21.99 | 23.13           | 24.40           | No Interference |
| C-CER 2016-6  |                           | 1.6                       |                      |                          |                       | 6                | 2.4                     | 1.51                     | 11°                                 | 45    | 4               | 4,560           | 6.35            |
| C-CER 2016-8  | 8                         |                           | 45                   | 4                        | 4,560                 | 8.44             |                         |                          |                                     | 8.86  | 9.32            | 9.84            | 11.06           |
| C-CER 2016-10 | 10                        |                           | 45                   | 4                        | 4,560                 | 10.54            |                         |                          |                                     | 11.06 | 11.64           | 12.28           | 13.79           |
| C-CER 2016-12 | 12                        |                           | 45                   | 4                        | 4,560                 | 12.63            |                         |                          |                                     | 13.26 | 13.95           | 14.71           | 16.53           |
| C-CER 2016-14 | 14                        |                           | 50                   | 4                        | 4,560                 | 14.72            |                         |                          |                                     | 15.45 | 16.26           | 17.15           | 19.27           |
| C-CER 2016-16 | 16                        |                           | 50                   | 4                        | 4,560                 | 16.82            |                         |                          |                                     | 17.65 | 18.57           | 19.59           | 22.01           |
| C-CER 2016-18 | 18                        |                           | 55                   | 4                        | 4,560                 | 18.91            |                         |                          |                                     | 19.85 | 20.88           | 22.03           | No Interference |
| C-CER 2016-20 | 20                        |                           | 55                   | 4                        | 4,560                 | 21.01            |                         |                          |                                     | 22.05 | 23.19           | 24.47           | No Interference |
| C-CER 2016-26 | 26                        |                           | 60                   | 4                        | 7,200                 | 27.29            |                         |                          |                                     | 28.64 | 30.13           | 31.78           | No Interference |
| C-CER 2018-6  | 1.8                       | 6                         | 2.7                  | 1.71                     | 11°                   | 45               | 4                       | 4,560                    | 6.35                                | 6.66  | 7.01            | 7.40            | 8.32            |
| C-CER 2018-8  |                           | 8                         |                      |                          |                       | 45               | 4                       | 4,560                    | 8.44                                | 8.86  | 9.32            | 9.84            | 11.06           |
| C-CER 2018-10 |                           | 10                        |                      |                          |                       | 45               | 4                       | 4,560                    | 10.54                               | 11.06 | 11.64           | 12.28           | 13.79           |
| C-CER 2018-12 |                           | 12                        |                      |                          |                       | 45               | 4                       | 4,560                    | 12.63                               | 13.26 | 13.95           | 14.71           | 16.53           |
| C-CER 2018-14 |                           | 14                        |                      |                          |                       | 50               | 4                       | 4,560                    | 14.72                               | 15.45 | 16.26           | 17.15           | 19.27           |
| C-CER 2018-16 |                           | 16                        |                      |                          |                       | 50               | 4                       | 4,560                    | 16.82                               | 17.65 | 18.57           | 19.59           | No Interference |
| C-CER 2018-18 |                           | 18                        |                      |                          |                       | 55               | 4                       | 4,560                    | 18.91                               | 19.85 | 20.88           | 22.03           | No Interference |
| C-CER 2018-20 |                           | 20                        |                      |                          |                       | 55               | 4                       | 4,560                    | 21.01                               | 22.05 | 23.19           | 24.47           | No Interference |
| C-CER 2018-25 |                           | 25                        |                      |                          |                       | 60               | 4                       | 6,240                    | 26.24                               | 27.54 | 28.97           | 30.56           | No Interference |
| C-CER 2020-6  | 2                         | 6                         | 3                    | 1.91                     | 11°                   | 45               | 4                       | 4,440                    | 6.35                                | 6.66  | 7.01            | 7.40            | 8.32            |
| C-CER 2020-8  |                           | 8                         |                      |                          |                       | 45               | 4                       | 4,440                    | 8.44                                | 8.86  | 9.32            | 9.84            | 11.06           |
| C-CER 2020-10 |                           | 10                        |                      |                          |                       | 45               | 4                       | 4,440                    | 10.54                               | 11.06 | 11.64           | 12.28           | 13.79           |
| C-CER 2020-12 |                           | 12                        |                      |                          |                       | 45               | 4                       | 4,440                    | 12.63                               | 13.26 | 13.95           | 14.71           | 16.53           |
| C-CER 2020-14 |                           | 14                        |                      |                          |                       | 50               | 4                       | 4,440                    | 14.72                               | 15.45 | 16.26           | 17.15           | 19.27           |
| C-CER 2020-16 |                           | 16                        |                      |                          |                       | 50               | 4                       | 4,440                    | 16.82                               | 17.65 | 18.57           | 19.59           | No Interference |
| C-CER 2020-18 |                           | 18                        |                      |                          |                       | 55               | 4                       | 4,440                    | 18.91                               | 19.85 | 20.88           | 22.03           | No Interference |
| C-CER 2020-20 |                           | 20                        |                      |                          |                       | 55               | 4                       | 4,440                    | 21.01                               | 22.05 | 23.19           | 24.47           | No Interference |
| C-CER 2020-25 |                           | 25                        |                      |                          |                       | 60               | 4                       | 4,440                    | 26.24                               | 27.54 | 28.97           | No Interference | No Interference |
| C-CER 2020-30 | 30                        | 70                        | 4                    | 5,520                    | 31.48                 | 33.03            | 34.75                   | No Interference          | No Interference                     |       |                 |                 |                 |
| C-CER 2025-8  | 2.5                       | 8                         | 3.7                  | 2.41                     | 11°                   | 45               | 4                       | 4,680                    | 8.44                                | 8.86  | 9.32            | 9.84            | 11.06           |
| C-CER 2025-10 |                           | 10                        |                      |                          |                       | 45               | 4                       | 4,680                    | 10.54                               | 11.06 | 11.64           | 12.28           | 13.79           |
| C-CER 2025-12 |                           | 12                        |                      |                          |                       | 45               | 4                       | 4,680                    | 12.63                               | 13.26 | 13.95           | 14.71           | No Interference |
| C-CER 2025-14 |                           | 14                        |                      |                          |                       | 50               | 4                       | 4,680                    | 14.72                               | 15.45 | 16.26           | 17.15           | No Interference |
| C-CER 2025-16 |                           | 16                        |                      |                          |                       | 50               | 4                       | 4,680                    | 16.82                               | 17.65 | 18.57           | 19.59           | No Interference |
| C-CER 2025-18 |                           | 18                        |                      |                          |                       | 55               | 4                       | 4,680                    | 18.91                               | 19.85 | 20.88           | No Interference | No Interference |
| C-CER 2025-20 |                           | 20                        |                      |                          |                       | 55               | 4                       | 4,680                    | 21.01                               | 22.05 | 23.19           | No Interference | No Interference |
| C-CER 2025-25 |                           | 25                        |                      |                          |                       | 60               | 4                       | 5,040                    | 26.24                               | 27.54 | 28.97           | No Interference | No Interference |
| C-CER 2025-30 |                           | 30                        |                      |                          |                       | 70               | 4                       | 5,040                    | 31.48                               | 33.03 | No Interference | No Interference | No Interference |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Unit (mm)

| Model Number  | Outside Diameter $\phi D$ | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |                 |                 |                 |                 |
|---------------|---------------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|               |                           |                        |                   |                          |                       |                  |                         |                          | 30'                                 | 1°              | 1° 30'          | 2°              | 3°              |                 |                 |                 |                 |
| C-CER 2030-8  | 3                         | 8                      | 4.5               | 2.92                     | 11°                   | 45               | 6                       | 6,000                    | 8.44                                | 8.86            | 9.32            | 9.83            | 11.05           |                 |                 |                 |                 |
| C-CER 2030-10 |                           | 10                     |                   |                          |                       | 45               | 6                       | 6,000                    | 10.53                               | 11.05           | 11.63           | 12.27           | 13.79           |                 |                 |                 |                 |
| C-CER 2030-12 |                           | 12                     |                   |                          |                       | 50               | 6                       | 6,000                    | 12.62                               | 13.25           | 13.94           | 14.71           | 16.53           |                 |                 |                 |                 |
| C-CER 2030-14 |                           | 14                     |                   |                          |                       | 50               | 6                       | 6,000                    | 14.72                               | 15.45           | 16.25           | 17.15           | 19.26           |                 |                 |                 |                 |
| C-CER 2030-16 |                           | 16                     |                   |                          |                       | 60               | 6                       | 6,000                    | 16.81                               | 17.65           | 18.56           | 19.58           | 22.00           |                 |                 |                 |                 |
| C-CER 2030-18 |                           | 18                     |                   |                          |                       | 60               | 6                       | 6,000                    | 18.91                               | 19.84           | 20.88           | 22.02           | 24.74           |                 |                 |                 |                 |
| C-CER 2030-20 |                           | 20                     |                   |                          |                       | 60               | 6                       | 6,000                    | 21.00                               | 22.04           | 23.19           | 24.46           | 27.48           |                 |                 |                 |                 |
| C-CER 2030-25 |                           | 25                     |                   |                          |                       | 70               | 6                       | 6,000                    | 26.24                               | 27.53           | 28.97           | 30.55           | No Interference |                 |                 |                 |                 |
| C-CER 2030-30 |                           | 30                     |                   |                          |                       | 80               | 6                       | 7,200                    | 31.47                               | 33.03           | 34.74           | 36.65           | No Interference |                 |                 |                 |                 |
| C-CER 2030-35 |                           | 35                     |                   |                          |                       | 80               | 6                       | 7,440                    | 36.71                               | 38.52           | 40.52           | 42.74           | No Interference |                 |                 |                 |                 |
| C-CER 2030-40 |                           | 40                     |                   |                          |                       | 90               | 6                       | 7,440                    | 41.94                               | 44.01           | 46.30           | No Interference | No Interference |                 |                 |                 |                 |
| C-CER 2035-12 |                           | 3.5                    |                   |                          |                       | 12               | 5                       | 3.37                     | 11°                                 | 50              | 6               | 8,400           | 12.76           | 13.39           | 14.09           | 14.86           | 16.70           |
| C-CER 2035-15 | 15                        |                        | 60                | 6                        | 8,400                 | 15.90            |                         |                          |                                     | 16.69           | 17.56           | 18.52           | 20.81           |                 |                 |                 |                 |
| C-CER 2035-16 | 16                        |                        | 60                | 6                        | 8,400                 | 16.95            |                         |                          |                                     | 17.79           | 18.71           | 19.74           | 22.18           |                 |                 |                 |                 |
| C-CER 2035-20 | 20                        |                        | 60                | 6                        | 8,400                 | 21.14            |                         |                          |                                     | 22.18           | 23.34           | 24.62           | No Interference |                 |                 |                 |                 |
| C-CER 2035-25 | 25                        |                        | 70                | 6                        | 8,400                 | 26.37            |                         |                          |                                     | 27.67           | 29.11           | 30.71           | No Interference |                 |                 |                 |                 |
| C-CER 2035-30 | 30                        |                        | 70                | 6                        | 8,400                 | 31.61            |                         |                          |                                     | 33.17           | 34.89           | No Interference | No Interference |                 |                 |                 |                 |
| C-CER 2035-35 | 35                        |                        | 80                | 6                        | 8,400                 | 36.84            |                         |                          |                                     | 38.66           | 40.67           | No Interference | No Interference |                 |                 |                 |                 |
| C-CER 2040-12 | 4                         |                        | 12                | 6                        | 3.82                  | 11°              |                         |                          |                                     | 50              | 6               | 6,960           | 12.89           | 13.53           | 14.24           | 15.02           | 16.88           |
| C-CER 2040-16 |                           |                        | 16                |                          |                       |                  |                         |                          |                                     | 60              | 6               | 6,960           | 17.08           | 17.93           | 18.86           | 19.90           | No Interference |
| C-CER 2040-20 |                           |                        | 20                |                          |                       |                  |                         |                          |                                     | 60              | 6               | 6,960           | 21.27           | 22.32           | 23.48           | 24.77           | No Interference |
| C-CER 2040-25 |                           |                        | 25                |                          |                       |                  |                         |                          |                                     | 70              | 6               | 6,960           | 26.51           | 27.82           | 29.26           | No Interference | No Interference |
| C-CER 2040-30 |                           |                        | 30                |                          |                       |                  |                         |                          |                                     | 70              | 6               | 6,960           | 31.74           | 33.31           | 35.04           | No Interference | No Interference |
| C-CER 2040-35 |                           | 35                     | 80                |                          |                       |                  | 6                       | 6,960                    | 36.98                               | 38.80           | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| C-CER 2040-40 |                           | 40                     | 90                |                          |                       |                  | 6                       | 8,760                    | 42.21                               | 44.30           | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| C-CER 2040-45 |                           | 45                     | 90                |                          |                       |                  | 6                       | 10,440                   | 47.45                               | 49.79           | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| C-CER 2040-50 |                           | 50                     | 100               |                          |                       |                  | 6                       | 12,960                   | 52.68                               | 55.28           | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| C-CER 2050-16 |                           | 5                      | 16                |                          |                       |                  | 7.5                     | 4.82                     | 11°                                 | 60              | 6               | 8,760           | 17.08           | 17.93           | 18.86           | No Interference | No Interference |
| C-CER 2050-20 |                           |                        | 20                |                          |                       |                  |                         |                          |                                     | 60              | 6               | 8,760           | 21.27           | 22.32           | No Interference | No Interference | No Interference |
| C-CER 2050-25 |                           |                        | 25                |                          |                       |                  |                         |                          |                                     | 60              | 6               | 8,760           | 26.51           | 27.82           | No Interference | No Interference | No Interference |
| C-CER 2050-30 | 30                        |                        | 80                | 6                        | 8,760                 | 31.74            |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| C-CER 2050-35 | 35                        |                        | 80                | 6                        | 8,760                 | 36.98            |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| C-CER 2050-40 | 40                        |                        | 80                | 6                        | 8,760                 | 42.21            |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| C-CER 2050-50 | 50                        |                        | 110               | 6                        | 13,800                | 52.68            |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| C-CER 2060-20 | 6                         |                        | 20                | 9                        | 5.82                  | —                |                         |                          |                                     | 80              | 6               | 9,000           | No Interference | No Interference | No Interference | No Interference | No Interference |
| C-CER 2060-30 |                           |                        | 30                |                          |                       |                  |                         |                          |                                     | 80              | 6               | 9,240           | No Interference | No Interference | No Interference | No Interference | No Interference |
| C-CER 2060-40 |                           |                        | 40                |                          |                       |                  |                         |                          |                                     | 100             | 6               | 10,920          | No Interference | No Interference | No Interference | No Interference | No Interference |
| C-CER 2060-50 |                           |                        | 50                |                          |                       |                  |                         |                          |                                     | 120             | 6               | 13,800          | No Interference | No Interference | No Interference | No Interference | No Interference |
| C-CER 2060-60 |                           |                        | 60                |                          |                       |                  |                         |                          |                                     | 120             | 6               | 16,440          | No Interference | No Interference | No Interference | No Interference | No Interference |

33mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for C-CER

| WORK MATERIAL |                       |                       | COPPER<br>OFC / TPC                |                    |                                 | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                 | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                 | HARDENED STEELS<br>SKD / SKT<br>(45~50HRC) |                    |                                 |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|---------------------------------|--|--------------------|---------------------------------|---|--------------------|---------------------------------|--|--------------------|---------------------------------|--|--------------------|---------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                               | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 2001          | 0.1                   | 0.3                   | 30,000                             | 30                 | 0.003~0.006                     | 30,000                                   | 30                 | 0.003~0.005                     | 30,000  | 15                 | 0.002~0.005                     | 30,000   | 16                 | 0.001~0.004                     | —  | —                  | —                               |
|               |                       | 0.5                   | 28,000                             | 28                 | 0.002~0.006                     | 28,000                                   | 28                 | 0.002~0.005                     | 28,000  | 14                 | 0.002~0.004                     | 28,000   | 14                 | 0.001~0.003                     | —  | —                  | —                               |
|               |                       | 0.75                  | 25,500                             | 26                 | 0.002~0.005                     | 25,500                                   | 26                 | 0.002~0.004                     | 25,500  | 13                 | 0.002~0.003                     | 25,500   | 12                 | 0.001~0.002                     | —  | —                  | —                               |
|               |                       | 1                     | 23,000                             | 5                  | 0.002~0.004                     | 23,000                                   | 5                  | 0.001~0.002                     | 23,000  | 5                  | 0.001~0.002                     | 23,000   | 5                  | 0.001                           | —  | —                  | —                               |
| 20015         | 0.15                  | 0.5                   | 30,000                             | 90                 | 0.004~0.008                     | 30,000                                   | 90                 | 0.004~0.007                     | 30,000  | 80                 | 0.003~0.006                     | 30,000   | 70                 | 0.003~0.005                     | 30,000                                     | 50                 | 0.003~0.004                     |
|               |                       | 0.75                  | 28,700                             | 90                 | 0.003~0.008                     | 28,700                                   | 90                 | 0.003~0.007                     | 28,700  | 80                 | 0.002~0.006                     | 28,700   | 70                 | 0.002~0.005                     | 28,700                                     | 50                 | 0.002~0.004                     |
|               |                       | 1                     | 27,300                             | 80                 | 0.002~0.006                     | 27,300                                   | 80                 | 0.002~0.006                     | 27,300  | 70                 | 0.001~0.005                     | 27,300   | 60                 | 0.001~0.004                     | 27,300                                     | 40                 | 0.001~0.003                     |
| 2002          | 0.2                   | 0.5                   | 43,000                             | 130                | 0.005~0.011                     | 43,000                                   | 130                | 0.005~0.009                     | 41,000  | 110                | 0.004~0.008                     | 39,000   | 90                 | 0.003~0.006                     | 39,000                                     | 40                 | 0.002~0.004                     |
|               |                       | 1                     | 34,000                             | 100                | 0.005~0.01                      | 34,000                                   | 100                | 0.005~0.008                     | 32,000  | 80                 | 0.004~0.007                     | 30,000   | 70                 | 0.003~0.006                     | 30,000                                     | 30                 | 0.002~0.004                     |
|               |                       | 1.5                   | 27,000                             | 80                 | 0.002~0.005                     | 27,000                                   | 80                 | 0.002~0.004                     | 24,000  | 60                 | 0.002~0.003                     | 23,000   | 50                 | 0.001~0.003                     | 23,000                                     | 20                 | 0.001~0.002                     |
|               |                       | 2                     | 21,900                             | 20                 | 0.002~0.004                     | 21,900                                   | 20                 | 0.001~0.002                     | 21,900  | 15                 | 0.001~0.002                     | 21,900   | 10                 | 0.001~0.002                     | 21,900                                     | 10                 | 0.001                           |
|               |                       | 3                     | 16,500                             | 10                 | 0.001~0.003                     | 16,500                                   | 10                 | 0.001~0.002                     | 16,500  | 8                  | 0.001~0.002                     | 16,500   | 5                  | 0.001~0.002                     | 16,500                                     | 5                  | 0.001                           |
|               |                       | 3                     | 16,500                             | 10                 | 0.001~0.003                     | 16,500                                   | 10                 | 0.001~0.002                     | 16,500  | 8                  | 0.001~0.002                     | 16,500   | 5                  | 0.001~0.002                     | 16,500                                     | 5                  | 0.001                           |
| 2003          | 0.3                   | 1                     | 49,000                             | 520                | 0.007~0.016                     | 49,000                                   | 440                | 0.007~0.013                     | 49,000  | 390                | 0.007~0.011                     | 49,000   | 350                | 0.005~0.009                     | 38,000                                     | 230                | 0.003~0.006                     |
|               |                       | 1.5                   | 43,000                             | 425                | 0.005~0.012                     | 43,000                                   | 360                | 0.005~0.01                      | 43,000  | 320                | 0.005~0.008                     | 43,000   | 285                | 0.004~0.007                     | 37,500                                     | 210                | 0.002~0.004                     |
|               |                       | 2                     | 37,000                             | 330                | 0.003~0.007                     | 37,000                                   | 280                | 0.003~0.006                     | 37,000  | 250                | 0.003~0.005                     | 37,000   | 220                | 0.002~0.004                     | 37,000                                     | 190                | 0.001~0.003                     |
|               |                       | 3                     | 31,000                             | 280                | 0.002~0.004                     | 31,000                                   | 240                | 0.002~0.003                     | 31,000  | 210                | 0.001~0.003                     | 31,000   | 190                | 0.001~0.002                     | 31,000                                     | 160                | 0.001~0.002                     |
| 2004          | 0.4                   | 2                     | 47,000                             | 720                | 0.01~0.02                       | 47,000                                   | 600                | 0.01~0.017                      | 47,000  | 560                | 0.009~0.015                     | 42,000   | 410                | 0.007~0.012                     | 30,000                                     | 250                | 0.005~0.008                     |
|               |                       | 3                     | 47,000                             | 630                | 0.005~0.01                      | 47,000                                   | 530                | 0.005~0.008                     | 47,000  | 470                | 0.004~0.007                     | 40,000   | 350                | 0.003~0.006                     | 30,000                                     | 220                | 0.002~0.004                     |
|               |                       | 4                     | 39,000                             | 520                | 0.002~0.005                     | 39,000                                   | 440                | 0.002~0.004                     | 37,000  | 370                | 0.002~0.004                     | 31,000   | 270                | 0.002~0.003                     | 30,000                                     | 220                | 0.001~0.002                     |
|               |                       | 5                     | 38,000                             | 440                | 0.002~0.005                     | 38,000                                   | 370                | 0.002~0.004                     | 32,000  | 280                | 0.002~0.003                     | 29,000   | 220                | 0.001~0.003                     | 28,000                                     | 180                | 0.001~0.002                     |
|               |                       | 5                     | 38,000                             | 440                | 0.002~0.005                     | 38,000                                   | 370                | 0.002~0.004                     | 32,000  | 280                | 0.002~0.003                     | 29,000   | 220                | 0.001~0.003                     | 28,000                                     | 180                | 0.001~0.002                     |
| 2005          | 0.5                   | 2                     | 47,000                             | 900                | 0.014~0.028                     | 47,000                                   | 750                | 0.014~0.023                     | 43,000  | 610                | 0.012~0.021                     | 38,000   | 460                | 0.009~0.016                     | 25,000                                     | 260                | 0.004~0.007                     |
|               |                       | 4                     | 43,000                             | 750                | 0.008~0.017                     | 43,000                                   | 630                | 0.008~0.014                     | 40,000  | 520                | 0.007~0.013                     | 28,000   | 320                | 0.006~0.01                      | 24,000                                     | 230                | 0.002~0.004                     |
|               |                       | 6                     | 31,000                             | 460                | 0.004~0.008                     | 31,000                                   | 390                | 0.004~0.007                     | 26,000  | 290                | 0.003~0.006                     | 24,000   | 230                | 0.002~0.004                     | 23,000                                     | 190                | 0.002~0.003                     |
|               |                       | 8                     | 25,000                             | 360                | 0.002~0.004                     | 25,000                                   | 300                | 0.002~0.003                     | 21,000  | 220                | 0.001~0.003                     | 19,000   | 180                | 0.001~0.002                     | 18,000                                     | 140                | 0.001~0.002                     |
| 2006          | 0.6                   | 2                     | 46,000                             | 1,050              | 0.018~0.036                     | 46,000                                   | 880                | 0.018~0.03                      | 40,000  | 670                | 0.016~0.027                     | 32,000   | 470                | 0.012~0.021                     | 21,000                                     | 270                | 0.009~0.015                     |
|               |                       | 4                     | 41,000                             | 790                | 0.01~0.02                       | 41,000                                   | 660                | 0.01~0.017                      | 34,000  | 520                | 0.009~0.016                     | 27,000   | 360                | 0.007~0.012                     | 20,000                                     | 230                | 0.005~0.008                     |
|               |                       | 6                     | 31,000                             | 600                | 0.005~0.011                     | 31,000                                   | 500                | 0.005~0.009                     | 26,000  | 370                | 0.005~0.008                     | 21,000   | 260                | 0.003~0.006                     | 20,000                                     | 210                | 0.002~0.004                     |
|               |                       | 8                     | 23,000                             | 360                | 0.002~0.005                     | 23,000                                   | 300                | 0.002~0.004                     | 19,000  | 220                | 0.002~0.003                     | 18,000   | 180                | 0.001~0.002                     | 16,000                                     | 140                | 0.001~0.002                     |
|               |                       | 10                    | 21,000                             | 330                | 0.002~0.005                     | 21,000                                   | 280                | 0.002~0.004                     | 17,000  | 200                | 0.002~0.003                     | 16,000   | 160                | 0.001~0.002                     | 15,000                                     | 130                | 0.001~0.002                     |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



## Milling Conditions for C-CER

| WORK MATERIAL |                       |                       | COPPER<br>OFC / TPC                |                    |                                 | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                 | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                 | HARDENED STEELS<br>SKD / SKT<br>(45~50HRC) |                    |                                 |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|---------------------------------|--|--------------------|---------------------------------|---|--------------------|---------------------------------|--|--------------------|---------------------------------|--|--------------------|---------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                               | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 2007          | 0.7                   | 2                     | 40,000                             | 1,050              | 0.026~0.053                     | 40,000                                   | 880                | 0.026~0.044                     | 34,000  | 670                | 0.023~0.039                     | 27,000   | 480                | 0.018~0.03                      | 18,000                                     | 270                | 0.013~0.022                     |
|               |                       | 3                     | 40,000                             | 1,050              | 0.022~0.044                     | 40,000                                   | 880                | 0.022~0.037                     | 34,000  | 670                | 0.02~0.033                      | 27,000   | 470                | 0.015~0.026                     | 18,000                                     | 270                | 0.011~0.018                     |
|               |                       | 4                     | 35,000                             | 810                | 0.012~0.024                     | 35,000                                   | 680                | 0.012~0.02                      | 29,000  | 510                | 0.01~0.018                      | 23,000   | 350                | 0.008~0.014                     | 17,000                                     | 230                | 0.006~0.01                      |
|               |                       | 6                     | 27,000                             | 620                | 0.006~0.013                     | 27,000                                   | 520                | 0.006~0.011                     | 22,000  | 380                | 0.005~0.009                     | 18,000   | 270                | 0.004~0.007                     | 17,000                                     | 220                | 0.003~0.005                     |
|               |                       | 8                     | 22,000                             | 460                | 0.005~0.011                     | 22,000                                   | 390                | 0.005~0.009                     | 18,000  | 290                | 0.005~0.008                     | 17,000   | 240                | 0.003~0.006                     | 16,000                                     | 190                | 0.002~0.004                     |
|               |                       | 10                    | 20,000                             | 360                | 0.002~0.005                     | 20,000                                   | 300                | 0.002~0.004                     | 16,000  | 220                | 0.002~0.004                     | 15,000   | 180                | 0.001~0.003                     | 14,000                                     | 140                | 0.001~0.002                     |
| 2008          | 0.8                   | 4                     | 35,000                             | 1,050              | 0.027~0.054                     | 35,000                                   | 880                | 0.027~0.045                     | 30,000  | 670                | 0.024~0.04                      | 24,000   | 470                | 0.019~0.031                     | 16,000                                     | 270                | 0.013~0.022                     |
|               |                       | 6                     | 31,000                             | 820                | 0.013~0.028                     | 31,000                                   | 690                | 0.013~0.023                     | 25,000  | 510                | 0.012~0.02                      | 20,000   | 350                | 0.009~0.016                     | 15,000                                     | 220                | 0.006~0.011                     |
|               |                       | 8                     | 23,000                             | 630                | 0.007~0.014                     | 23,000                                   | 530                | 0.007~0.012                     | 19,000  | 390                | 0.006~0.011                     | 15,000   | 270                | 0.005~0.008                     | 15,000                                     | 220                | 0.003~0.006                     |
|               |                       | 10                    | 19,000                             | 450                | 0.006~0.012                     | 19,000                                   | 380                | 0.006~0.01                      | 16,000  | 280                | 0.005~0.009                     | 15,000   | 230                | 0.004~0.007                     | 14,000                                     | 180                | 0.003~0.005                     |
|               |                       | 12                    | 17,000                             | 360                | 0.003~0.006                     | 17,000                                   | 300                | 0.003~0.005                     | 14,000  | 220                | 0.002~0.004                     | 13,000   | 180                | 0.002~0.003                     | 12,000                                     | 140                | 0.001~0.002                     |
| 2009          | 0.9                   | 4                     | 31,000                             | 1,090              | 0.028~0.058                     | 31,000                                   | 910                | 0.028~0.048                     | 26,000  | 690                | 0.026~0.043                     | 21,000   | 480                | 0.02~0.033                      | 14,000                                     | 270                | 0.014~0.024                     |
|               |                       | 6                     | 27,000                             | 840                | 0.014~0.029                     | 27,000                                   | 700                | 0.014~0.024                     | 22,000  | 510                | 0.013~0.022                     | 18,000   | 360                | 0.01~0.017                      | 13,000                                     | 230                | 0.007~0.012                     |
|               |                       | 8                     | 21,000                             | 640                | 0.008~0.016                     | 21,000                                   | 540                | 0.008~0.013                     | 17,000  | 400                | 0.007~0.012                     | 14,000   | 280                | 0.005~0.009                     | 13,000                                     | 230                | 0.004~0.006                     |
|               |                       | 10                    | 17,000                             | 460                | 0.006~0.013                     | 17,000                                   | 390                | 0.006~0.011                     | 14,000  | 290                | 0.006~0.01                      | 13,000   | 230                | 0.004~0.007                     | 12,000                                     | 190                | 0.003~0.005                     |
|               |                       | 15                    | 11,000                             | 320                | 0.003~0.006                     | 11,000                                   | 270                | 0.003~0.005                     | 13,000  | 200                | 0.003~0.005                     | 12,000   | 160                | 0.002~0.003                     | 11,000                                     | 130                | 0.001~0.002                     |
| 2010          | 1                     | 4                     | 28,000                             | 1,120              | 0.03~0.06                       | 28,000                                   | 940                | 0.03~0.05                       | 23,000  | 710                | 0.027~0.045                     | 19,000   | 490                | 0.021~0.035                     | 12,700                                     | 280                | 0.015~0.025                     |
|               |                       | 6                     | 24,000                             | 850                | 0.015~0.03                      | 24,000                                   | 710                | 0.015~0.025                     | 20,000  | 520                | 0.013~0.023                     | 16,000   | 360                | 0.01~0.017                      | 12,000                                     | 230                | 0.007~0.012                     |
|               |                       | 8                     | 24,000                             | 850                | 0.015~0.03                      | 24,000                                   | 710                | 0.015~0.025                     | 20,000  | 520                | 0.013~0.023                     | 16,000   | 360                | 0.01~0.017                      | 12,000                                     | 230                | 0.007~0.012                     |
|               |                       | 10                    | 19,000                             | 640                | 0.008~0.017                     | 19,000                                   | 540                | 0.008~0.014                     | 15,000  | 400                | 0.007~0.012                     | 12,000   | 280                | 0.005~0.009                     | 12,000                                     | 230                | 0.004~0.007                     |
|               |                       | 12                    | 15,000                             | 460                | 0.007~0.014                     | 15,000                                   | 390                | 0.007~0.012                     | 13,000  | 290                | 0.006~0.01                      | 12,000   | 230                | 0.005~0.008                     | 11,400                                     | 190                | 0.003~0.006                     |
|               |                       | 16                    | 12,000                             | 360                | 0.003~0.007                     | 12,000                                   | 300                | 0.003~0.006                     | 10,500  | 220                | 0.003~0.005                     | 9,700  | 180                | 0.002~0.004                     | 9,100                                      | 140                | 0.001~0.003                     |
|               |                       | 20                    | 10,000                             | 320                | 0.003~0.007                     | 10,000                                   | 270                | 0.003~0.006                     | 8,400   | 200                | 0.003~0.005                     | 7,700  | 160                | 0.002~0.004                     | 7,300                                      | 130                | 0.001~0.003                     |
| 2012          | 1.2                   | 6                     | 23,000                             | 1,050              | 0.036~0.072                     | 23,000                                   | 880                | 0.036~0.06                      | 20,000  | 670                | 0.032~0.054                     | 16,000   | 470                | 0.025~0.042                     | 10,000                                     | 260                | 0.018~0.03                      |
|               |                       | 8                     | 20,000                             | 820                | 0.018~0.036                     | 20,000                                   | 690                | 0.018~0.03                      | 16,000  | 500                | 0.016~0.027                     | 13,000   | 350                | 0.012~0.021                     | 10,000                                     | 220                | 0.009~0.015                     |
|               |                       | 10                    | 15,000                             | 630                | 0.01~0.019                      | 15,000                                   | 530                | 0.01~0.016                      | 13,000  | 390                | 0.009~0.015                     | 10,600   | 270                | 0.007~0.011                     | 10,000                                     | 220                | 0.005~0.008                     |
|               |                       | 12                    | 15,000                             | 630                | 0.01~0.019                      | 15,000                                   | 530                | 0.01~0.016                      | 13,000  | 390                | 0.009~0.015                     | 10,600   | 270                | 0.007~0.011                     | 10,000                                     | 220                | 0.005~0.008                     |
|               |                       | 16                    | 11,000                             | 320                | 0.004~0.008                     | 11,000                                   | 270                | 0.004~0.007                     | 9,000   | 200                | 0.003~0.006                     | 9,000  | 160                | 0.003~0.005                     | 8,400                                      | 130                | 0.002~0.003                     |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius

Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Ball

Long Neck  
Ball

Taper

Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral  
V CutterSpiral  
V Cutter

Drill

Drill

Technical Data

Technical Data

Milling Conditions for C-CER

| WORK MATERIAL |                       | COPPER<br>OFC / TPC   |                                    |                    | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                                    |                    | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                                    |                    | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                                    |                    | HARDENED STEELS<br>SKD / SKT<br>(45~50HRC) |                                    |                    |                                 |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|--|------------------------------------|--------------------|---|------------------------------------|--------------------|--|------------------------------------|--------------------|--|------------------------------------|--------------------|---------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm)          | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm)               | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm)                                  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm)            | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 2014          | 1.4                   | 6                     | 20,000                             | 1,000              | 0.042~0.084                              | 20,000                             | 840                | 0.042~0.07                                    | 17,000                             | 640                | 0.038~0.063  | 13,000                             | 440                | 0.029~0.049                                | 9,000                              | 250                | 0.021~0.035                     |
|               |                       | 8                     | 17,000                             | 790                | 0.021~0.042                              | 17,000                             | 660                | 0.021~0.035                                   | 14,000                             | 480                | 0.019~0.032  | 11,500                             | 330                | 0.015~0.025                                | 8,600                              | 210                | 0.01~0.017                      |
|               |                       | 10                    | 17,000                             | 790                | 0.021~0.042                              | 17,000                             | 660                | 0.021~0.035                                   | 14,000                             | 480                | 0.019~0.032  | 11,500                             | 330                | 0.015~0.025                                | 8,600                              | 210                | 0.01~0.017                      |
|               |                       | 12                    | 13,000                             | 620                | 0.011~0.023                              | 13,000                             | 520                | 0.011~0.019                                   | 11,000                             | 380                | 0.01~0.017   | 9,000                              | 270                | 0.008~0.013                                | 8,600                              | 220                | 0.005~0.009                     |
|               |                       | 14                    | 13,000                             | 620                | 0.011~0.023                              | 13,000                             | 520                | 0.011~0.019                                   | 11,000                             | 380                | 0.01~0.017   | 9,000                              | 270                | 0.008~0.013                                | 8,600                              | 220                | 0.005~0.009                     |
|               |                       | 16                    | 11,000                             | 430                | 0.01~0.02                                | 11,000                             | 360                | 0.01~0.017                                    | 9,000                              | 270                | 0.009~0.015  | 8,000                              | 220                | 0.007~0.011                                | 8,100                              | 180                | 0.005~0.008                     |
|               |                       | 22                    | 10,000                             | 310                | 0.005~0.01                               | 10,000                             | 260                | 0.005~0.008                                   | 8,000                              | 190                | 0.004~0.007  | 7,000                              | 150                | 0.003~0.005                                | 7,200                              | 120                | 0.002~0.004                     |
| 2015          | 1.5                   | 6                     | 18,000                             | 1,030              | 0.045~0.09                               | 18,000                             | 860                | 0.045~0.075                                   | 15,000                             | 650                | 0.04~0.068   | 12,000                             | 460                | 0.031~0.052                                | 8,400                              | 260                | 0.022~0.037                     |
|               |                       | 8                     | 16,000                             | 810                | 0.023~0.046                              | 16,000                             | 680                | 0.023~0.038                                   | 13,000                             | 500                | 0.02~0.034   | 10,000                             | 340                | 0.016~0.026                                | 8,000                              | 220                | 0.011~0.019                     |
|               |                       | 10                    | 16,000                             | 810                | 0.023~0.046                              | 16,000                             | 680                | 0.023~0.038                                   | 13,000                             | 500                | 0.02~0.034   | 10,000                             | 340                | 0.016~0.026                                | 8,000                              | 220                | 0.011~0.019                     |
|               |                       | 12                    | 16,000                             | 810                | 0.023~0.046                              | 16,000                             | 680                | 0.023~0.038                                   | 13,000                             | 500                | 0.02~0.034   | 10,000                             | 340                | 0.016~0.026                                | 8,000                              | 220                | 0.011~0.019                     |
|               |                       | 14                    | 12,700                             | 620                | 0.012~0.025                              | 12,700                             | 520                | 0.012~0.021                                   | 10,600                             | 390                | 0.011~0.018  | 8,400                              | 270                | 0.008~0.014                                | 8,000                              | 220                | 0.006~0.01                      |
|               |                       | 16                    | 10,300                             | 450                | 0.01~0.022                               | 10,300                             | 380                | 0.01~0.018                                    | 8,600                              | 280                | 0.009~0.016  | 8,000                              | 230                | 0.007~0.012                                | 7,600                              | 180                | 0.005~0.009                     |
|               |                       | 18                    | 10,300                             | 450                | 0.01~0.022                               | 10,300                             | 380                | 0.01~0.018                                    | 8,600                              | 280                | 0.009~0.016  | 8,000                              | 230                | 0.007~0.012                                | 7,600                              | 180                | 0.005~0.009                     |
| 2016          | 1.6                   | 20                    | 9,000                              | 320                | 0.005~0.011                              | 9,000                              | 270                | 0.005~0.009                                   | 7,000                              | 200                | 0.004~0.008  | 7,200                              | 160                | 0.003~0.006                                | 6,700                              | 130                | 0.002~0.004                     |
|               |                       | 6                     | 17,000                             | 1,050              | 0.048~0.096                              | 17,000                             | 880                | 0.048~0.08                                    | 14,000                             | 670                | 0.043~0.072  | 11,900                             | 470                | 0.033~0.056                                | 7,900                              | 260                | 0.024~0.04                      |
|               |                       | 8                     | 17,000                             | 1,050              | 0.048~0.096                              | 17,000                             | 880                | 0.048~0.08                                    | 14,000                             | 670                | 0.043~0.072  | 11,900                             | 470                | 0.033~0.056                                | 7,900                              | 260                | 0.024~0.04                      |
|               |                       | 10                    | 15,000                             | 820                | 0.024~0.048                              | 15,000                             | 690                | 0.024~0.04                                    | 12,700                             | 500                | 0.022~0.036  | 10,100                             | 350                | 0.017~0.028                                | 7,500                              | 220                | 0.012~0.02                      |
|               |                       | 12                    | 15,000                             | 820                | 0.024~0.048                              | 15,000                             | 690                | 0.024~0.04                                    | 12,700                             | 500                | 0.022~0.036  | 10,100                             | 350                | 0.017~0.028                                | 7,500                              | 220                | 0.012~0.02                      |
|               |                       | 14                    | 11,900                             | 630                | 0.013~0.026                              | 11,900                             | 530                | 0.013~0.022                                   | 9,900                              | 390                | 0.012~0.02   | 7,900                              | 270                | 0.009~0.015                                | 7,500                              | 220                | 0.006~0.011                     |
|               |                       | 16                    | 11,900                             | 630                | 0.013~0.026                              | 11,900                             | 530                | 0.013~0.022                                   | 9,900                              | 390                | 0.012~0.02   | 7,900                              | 270                | 0.009~0.015                                | 7,500                              | 220                | 0.006~0.011                     |
|               |                       | 18                    | 9,700                              | 460                | 0.011~0.023                              | 9,700                              | 390                | 0.011~0.019                                   | 8,100                              | 290                | 0.01~0.017   | 7,500                              | 230                | 0.008~0.013                                | 7,100                              | 190                | 0.005~0.009                     |
| 2018          | 1.8                   | 20                    | 9,000                              | 450                | 0.011~0.023                              | 9,000                              | 380                | 0.011~0.019                                   | 8,100                              | 280                | 0.01~0.017   | 7,500                              | 230                | 0.008~0.013                                | 7,100                              | 180                | 0.005~0.009                     |
|               |                       | 26                    | 8,000                              | 280                | 0.005~0.011                              | 8,000                              | 240                | 0.005~0.009                                   | 7,300                              | 180                | 0.005~0.008  | 6,700                              | 140                | 0.004~0.006                                | 6,300                              | 120                | 0.002~0.004                     |
|               |                       | 6                     | 15,000                             | 1,030              | 0.051~0.102                              | 15,000                             | 860                | 0.051~0.085                                   | 13,200                             | 650                | 0.045~0.076  | 10,600                             | 460                | 0.035~0.059                                | 7,000                              | 260                | 0.025~0.042                     |
|               |                       | 8                     | 15,000                             | 1,030              | 0.051~0.102                              | 15,000                             | 860                | 0.051~0.085                                   | 13,200                             | 650                | 0.045~0.076  | 10,600                             | 460                | 0.035~0.059                                | 7,000                              | 260                | 0.025~0.042                     |
|               |                       | 10                    | 13,700                             | 810                | 0.027~0.055                              | 13,700                             | 680                | 0.027~0.046                                   | 11,400                             | 500                | 0.024~0.041  | 9,000                              | 340                | 0.019~0.032                                | 6,700                              | 220                | 0.013~0.023                     |
|               |                       | 12                    | 13,700                             | 810                | 0.027~0.055                              | 13,700                             | 680                | 0.027~0.046                                   | 11,400                             | 500                | 0.024~0.041  | 9,000                              | 340                | 0.019~0.032                                | 6,700                              | 220                | 0.013~0.023                     |
|               |                       | 14                    | 13,700                             | 810                | 0.027~0.055                              | 13,700                             | 680                | 0.027~0.046                                   | 11,400                             | 500                | 0.024~0.041  | 9,000                              | 340                | 0.019~0.032                                | 6,700                              | 220                | 0.013~0.023                     |
|               |                       | 16                    | 10,600                             | 620                | 0.015~0.03                               | 10,600                             | 520                | 0.015~0.025                                   | 8,800                              | 380                | 0.013~0.022  | 7,000                              | 270                | 0.01~0.017                                 | 6,700                              | 220                | 0.007~0.012                     |
|               |                       | 18                    | 10,600                             | 620                | 0.015~0.03                               | 10,600                             | 520                | 0.015~0.025                                   | 8,800                              | 380                | 0.013~0.022  | 7,000                              | 270                | 0.01~0.017                                 | 6,700                              | 220                | 0.007~0.012                     |
|               |                       | 20                    | 8,600                              | 450                | 0.012~0.024                              | 8,600                              | 380                | 0.012~0.02                                    | 7,200                              | 280                | 0.01~0.018   | 6,700                              | 230                | 0.008~0.014                                | 6,300                              | 180                | 0.006~0.01                      |
| 25            | 7,700                 | 310                   | 0.006~0.012                        | 7,700              | 260                                      | 0.006~0.01                         | 6,500              | 200   | 0.005~0.009                        | 6,000              | 160  | 0.004~0.007                        | 5,600              | 130  | 0.003~0.005                        |                    |                                 |

## Milling Conditions for C-CER

| WORK MATERIAL |                       |                       | COPPER<br>OFC / TPC                |                    |                                 |                                    | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                                 |                                    | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                                 |                                    | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                                 |                                    | HARDENED STEELS<br>SKD / SKT<br>(45~50HRC) |                                 |  |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|---------------------------------|------------------------------------|--|---------------------------------|------------------------------------|---|---------------------------------|------------------------------------|--|---------------------------------|------------------------------------|--|---------------------------------|--|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)                       | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)                            | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)   | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)                         | a <sub>p</sub> Axial Depth (mm) |  |
| 2020          | 2                     | 6                     | 14,000                             | 1,080              | 0.058~0.118                     | 14,000                             | 900                                      | 0.058~0.098                     | 12,000                             | 680   | 0.052~0.088                     | 9,600                              | 480  | 0.041~0.068                     | 6,400                              | 270  | 0.029~0.049                     |  |
|               |                       | 8                     | 14,000                             | 1,020              | 0.052~0.106                     | 14,000                             | 850                                      | 0.052~0.088                     | 12,000                             | 650   | 0.047~0.079                     | 9,600                              | 450  | 0.037~0.061                     | 6,400                              | 260  | 0.026~0.044                     |  |
|               |                       | 10                    | 14,000                             | 1,020              | 0.052~0.106                     | 14,000                             | 850                                      | 0.052~0.088                     | 12,000                             | 650   | 0.047~0.079                     | 9,600                              | 450  | 0.037~0.061                     | 6,400                              | 260  | 0.026~0.044                     |  |
|               |                       | 12                    | 12,300                             | 790                | 0.026~0.053                     | 12,300                             | 660                                      | 0.026~0.044                     | 10,400                             | 500   | 0.024~0.04                      | 8,100                              | 340  | 0.018~0.031                     | 6,000                              | 220  | 0.013~0.022                     |  |
|               |                       | 14                    | 12,300                             | 790                | 0.026~0.053                     | 12,300                             | 660                                      | 0.026~0.044                     | 10,400                             | 500   | 0.024~0.04                      | 8,100                              | 340  | 0.018~0.031                     | 6,000                              | 220  | 0.013~0.022                     |  |
|               |                       | 16                    | 12,300                             | 790                | 0.026~0.053                     | 12,300                             | 660                                      | 0.026~0.044                     | 10,400                             | 500   | 0.024~0.04                      | 8,100                              | 340  | 0.018~0.031                     | 6,000                              | 220  | 0.013~0.022                     |  |
|               |                       | 18                    | 9,500                              | 610                | 0.014~0.029                     | 9,500                              | 510                                      | 0.014~0.024                     | 7,900                              | 380   | 0.013~0.022                     | 6,300                              | 270  | 0.01~0.017                      | 6,000                              | 220  | 0.007~0.012                     |  |
|               |                       | 20                    | 9,500                              | 610                | 0.014~0.029                     | 9,500                              | 510                                      | 0.014~0.024                     | 7,900                              | 380   | 0.013~0.022                     | 6,300                              | 270  | 0.01~0.017                      | 6,000                              | 220  | 0.007~0.012                     |  |
|               |                       | 25                    | 7,700                              | 430                | 0.012~0.025                     | 7,700                              | 360                                      | 0.012~0.021                     | 6,400                              | 270   | 0.011~0.018                     | 6,000                              | 220  | 0.008~0.014                     | 5,700                              | 180  | 0.006~0.01                      |  |
|               |                       | 30                    | 7,000                              | 310                | 0.006~0.012                     | 7,000                              | 260                                      | 0.006~0.01                      | 5,800                              | 190   | 0.005~0.009                     | 5,400                              | 150  | 0.004~0.007                     | 5,000                              | 120  | 0.003~0.005                     |  |
| 2025          | 2.5                   | 8                     | 10,800                             | 1,390              | 0.066~0.132                     | 10,800                             | 1,160                                    | 0.066~0.11                      | 9,100                              | 880   | 0.059~0.099                     | 7,600                              | 640  | 0.046~0.077                     | 5,100                              | 360  | 0.033~0.055                     |  |
|               |                       | 10                    | 10,800                             | 1,390              | 0.066~0.132                     | 10,800                             | 1,160                                    | 0.066~0.11                      | 9,100                              | 880   | 0.059~0.099                     | 7,600                              | 640  | 0.046~0.077                     | 5,100                              | 360  | 0.033~0.055                     |  |
|               |                       | 12                    | 10,800                             | 1,390              | 0.066~0.132                     | 10,800                             | 1,160                                    | 0.066~0.11                      | 9,100                              | 880   | 0.059~0.099                     | 7,600                              | 640  | 0.046~0.077                     | 5,100                              | 360  | 0.033~0.055                     |  |
|               |                       | 14                    | 9,500                              | 1,090              | 0.033~0.067                     | 9,500                              | 910                                      | 0.033~0.056                     | 8,000                              | 680   | 0.03~0.05                       | 6,500                              | 490  | 0.023~0.039                     | 4,800                              | 310  | 0.016~0.028                     |  |
|               |                       | 16                    | 9,500                              | 1,090              | 0.033~0.067                     | 9,500                              | 910                                      | 0.033~0.056                     | 8,000                              | 680   | 0.03~0.05                       | 6,500                              | 490  | 0.023~0.039                     | 4,800                              | 310  | 0.016~0.028                     |  |
|               |                       | 18                    | 9,500                              | 1,090              | 0.033~0.067                     | 9,500                              | 910                                      | 0.033~0.056                     | 8,000                              | 680   | 0.03~0.05                       | 6,500                              | 490  | 0.023~0.039                     | 4,800                              | 310  | 0.016~0.028                     |  |
|               |                       | 20                    | 9,500                              | 1,090              | 0.033~0.067                     | 9,500                              | 910                                      | 0.033~0.056                     | 8,000                              | 680   | 0.03~0.05                       | 6,500                              | 490  | 0.023~0.039                     | 4,800                              | 310  | 0.016~0.028                     |  |
|               |                       | 25                    | 7,600                              | 820                | 0.018~0.036                     | 7,600                              | 690                                      | 0.018~0.03                      | 6,300                              | 510   | 0.016~0.027                     | 5,000                              | 360  | 0.012~0.021                     | 4,800                              | 290  | 0.009~0.015                     |  |
|               |                       | 30                    | 6,200                              | 480                | 0.014~0.029                     | 6,200                              | 400                                      | 0.014~0.024                     | 5,200                              | 300   | 0.013~0.022                     | 4,800                              | 240  | 0.01~0.017                      | 4,500                              | 200  | 0.007~0.012                     |  |
| 2030          | 3                     | 8                     | 8,700                              | 1,580              | 0.088~0.176                     | 8,700                              | 1,320                                    | 0.088~0.147                     | 7,300                              | 990   | 0.079~0.132                     | 5,900                              | 700  | 0.055~0.092                     | 4,200                              | 420  | 0.044~0.073                     |  |
|               |                       | 10                    | 8,700                              | 1,500              | 0.079~0.158                     | 8,700                              | 1,250                                    | 0.079~0.132                     | 7,300                              | 940   | 0.071~0.119                     | 5,900                              | 660  | 0.055~0.092                     | 4,200                              | 400  | 0.039~0.066                     |  |
|               |                       | 12                    | 8,700                              | 1,500              | 0.079~0.158                     | 8,700                              | 1,250                                    | 0.079~0.132                     | 7,300                              | 940   | 0.071~0.119                     | 5,900                              | 660  | 0.055~0.092                     | 4,200                              | 400  | 0.039~0.066                     |  |
|               |                       | 14                    | 8,700                              | 1,500              | 0.079~0.158                     | 8,700                              | 1,250                                    | 0.079~0.132                     | 7,300                              | 940   | 0.071~0.119                     | 5,900                              | 660  | 0.055~0.092                     | 4,200                              | 400  | 0.039~0.066                     |  |
|               |                       | 16                    | 7,600                              | 1,160              | 0.04~0.08                       | 7,600                              | 970                                      | 0.04~0.067                      | 6,300                              | 720   | 0.036~0.06                      | 5,000                              | 500  | 0.028~0.047                     | 3,900                              | 340  | 0.02~0.033                      |  |
|               |                       | 18                    | 7,600                              | 1,160              | 0.04~0.08                       | 7,600                              | 970                                      | 0.04~0.067                      | 6,300                              | 720   | 0.036~0.06                      | 5,000                              | 500  | 0.028~0.047                     | 3,900                              | 340  | 0.02~0.033                      |  |
|               |                       | 20                    | 7,600                              | 1,160              | 0.04~0.08                       | 7,600                              | 970                                      | 0.04~0.067                      | 6,300                              | 720   | 0.036~0.06                      | 5,000                              | 500  | 0.028~0.047                     | 3,900                              | 340  | 0.02~0.033                      |  |
|               |                       | 25                    | 6,300                              | 970                | 0.022~0.043                     | 6,300                              | 810                                      | 0.022~0.036                     | 5,300                              | 600   | 0.019~0.033                     | 4,200                              | 420  | 0.015~0.025                     | 3,900                              | 340  | 0.011~0.018                     |  |
|               |                       | 30                    | 6,300                              | 970                | 0.022~0.043                     | 6,300                              | 810                                      | 0.022~0.036                     | 5,300                              | 600   | 0.019~0.033                     | 4,200                              | 420  | 0.015~0.025                     | 3,900                              | 340  | 0.011~0.018                     |  |
|               |                       | 35                    | 5,100                              | 490                | 0.017~0.035                     | 5,100                              | 410                                      | 0.017~0.029                     | 4,300                              | 300   | 0.016~0.026                     | 4,000                              | 240  | 0.012~0.02                      | 3,800                              | 200  | 0.008~0.014                     |  |
|               |                       | 40                    | 4,600                              | 310                | 0.007~0.014                     | 4,600                              | 260                                      | 0.007~0.012                     | 3,900                              | 200   | 0.006~0.01                      | 3,600                              | 160  | 0.005~0.008                     | 3,300                              | 130  | 0.003~0.006                     |  |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

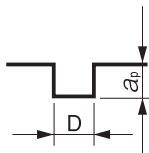
Drill

Technical Data

Milling Conditions for C-CER

| WORK MATERIAL |                       |                       | COPPER<br>OFC / TPC                |                    |                                 | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                 | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                 | HARDENED STEELS<br>SKD / SKT<br>(45~50HRC) |                    |                                 |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|---------------------------------|--|--------------------|---------------------------------|---|--------------------|---------------------------------|--|--------------------|---------------------------------|--|--------------------|---------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                               | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 2035          | 3.5                   | 12                    | 7,100                              | 1,280              | 0.092~0.185                     | 7,100                                    | 1,070              | 0.092~0.154                     | 6,000   | 790                | 0.083~0.138                     | 4,800  | 560                | 0.064~0.108                     | 3,300                                      | 330                | 0.046~0.077                     |
|               |                       | 15                    | 7,100                              | 1,280              | 0.092~0.185                     | 7,100                                    | 1,070              | 0.092~0.154                     | 6,000   | 790                | 0.083~0.138                     | 4,800  | 560                | 0.064~0.108                     | 3,300                                      | 330                | 0.046~0.077                     |
|               |                       | 16                    | 7,100                              | 1,280              | 0.092~0.185                     | 7,100                                    | 1,070              | 0.092~0.154                     | 6,000   | 790                | 0.083~0.138                     | 4,800  | 560                | 0.064~0.108                     | 3,300                                      | 330                | 0.046~0.077                     |
|               |                       | 20                    | 6,200                              | 990                | 0.043~0.086                     | 6,200                                    | 830                | 0.043~0.072                     | 5,100   | 610                | 0.039~0.065                     | 4,000  | 420                | 0.03~0.05                       | 3,100                                      | 280                | 0.021~0.036                     |
|               |                       | 25                    | 6,200                              | 990                | 0.043~0.086                     | 6,200                                    | 830                | 0.043~0.072                     | 5,100   | 610                | 0.039~0.065                     | 4,000  | 420                | 0.03~0.05                       | 3,100                                      | 280                | 0.021~0.036                     |
|               |                       | 30                    | 5,000                              | 800                | 0.025~0.05                      | 5,000                                    | 670                | 0.025~0.042                     | 4,200   | 500                | 0.023~0.038                     | 3,300  | 340                | 0.018~0.03                      | 3,100                                      | 280                | 0.012~0.021                     |
|               |                       | 35                    | 5,000                              | 800                | 0.025~0.05                      | 5,000                                    | 670                | 0.025~0.042                     | 4,200   | 500                | 0.023~0.038                     | 3,300  | 340                | 0.018~0.03                      | 3,100                                      | 280                | 0.012~0.021                     |
| 2040          | 4                     | 12                    | 6,000                              | 1,170              | 0.1~0.202                       | 6,000                                    | 980                | 0.1~0.168                       | 5,000   | 720                | 0.09~0.151                      | 3,900  | 500                | 0.07~0.117                      | 2,700                                      | 290                | 0.05~0.084                      |
|               |                       | 16                    | 6,000                              | 1,110              | 0.09~0.181                      | 6,000                                    | 930                | 0.09~0.151                      | 5,000   | 690                | 0.081~0.136                     | 3,900  | 480                | 0.063~0.105                     | 2,700                                      | 280                | 0.045~0.075                     |
|               |                       | 20                    | 6,000                              | 1,110              | 0.09~0.181                      | 6,000                                    | 930                | 0.09~0.151                      | 5,000   | 690                | 0.081~0.136                     | 3,900  | 480                | 0.063~0.105                     | 2,700                                      | 280                | 0.045~0.075                     |
|               |                       | 25                    | 5,200                              | 860                | 0.046~0.091                     | 5,200                                    | 720                | 0.046~0.076                     | 4,200   | 520                | 0.041~0.069                     | 3,300  | 350                | 0.032~0.053                     | 2,500                                      | 230                | 0.023~0.038                     |
|               |                       | 30                    | 5,200                              | 860                | 0.046~0.091                     | 5,200                                    | 720                | 0.046~0.076                     | 4,200   | 520                | 0.041~0.069                     | 3,300  | 350                | 0.032~0.053                     | 2,500                                      | 230                | 0.023~0.038                     |
|               |                       | 35                    | 4,200                              | 660                | 0.025~0.05                      | 4,200                                    | 550                | 0.025~0.042                     | 3,500   | 400                | 0.022~0.037                     | 2,700  | 270                | 0.017~0.029                     | 2,500                                      | 220                | 0.012~0.021                     |
|               |                       | 40                    | 4,200                              | 660                | 0.025~0.05                      | 4,200                                    | 550                | 0.025~0.042                     | 3,500   | 400                | 0.022~0.037                     | 2,700  | 270                | 0.017~0.029                     | 2,500                                      | 220                | 0.012~0.021                     |
|               |                       | 45                    | 3,400                              | 430                | 0.018~0.037                     | 3,400                                    | 360                | 0.018~0.031                     | 2,800   | 270                | 0.016~0.028                     | 2,500  | 210                | 0.013~0.021                     | 2,300                                      | 160                | 0.009~0.015                     |
|               |                       | 50                    | 3,400                              | 380                | 0.018~0.037                     | 3,400                                    | 320                | 0.018~0.031                     | 2,800   | 240                | 0.016~0.028                     | 2,500  | 190                | 0.013~0.021                     | 2,300                                      | 140                | 0.009~0.015                     |
| 2050          | 5                     | 16                    | 4,400                              | 870                | 0.113~0.227                     | 4,400                                    | 730                | 0.113~0.189                     | 3,600   | 530                | 0.102~0.17                      | 2,800  | 360                | 0.079~0.132                     | 1,700                                      | 190                | 0.056~0.094                     |
|               |                       | 20                    | 4,400                              | 870                | 0.113~0.227                     | 4,400                                    | 730                | 0.113~0.189                     | 3,600   | 530                | 0.102~0.17                      | 2,800  | 360                | 0.079~0.132                     | 1,700                                      | 190                | 0.056~0.094                     |
|               |                       | 25                    | 4,400                              | 870                | 0.113~0.227                     | 4,400                                    | 730                | 0.113~0.189                     | 3,600   | 530                | 0.102~0.17                      | 2,800  | 360                | 0.079~0.132                     | 1,700                                      | 190                | 0.056~0.094                     |
|               |                       | 30                    | 3,800                              | 630                | 0.057~0.115                     | 3,800                                    | 530                | 0.057~0.096                     | 3,000   | 380                | 0.051~0.086                     | 2,200  | 240                | 0.04~0.067                      | 1,600                                      | 150                | 0.028~0.048                     |
|               |                       | 35                    | 3,800                              | 630                | 0.057~0.115                     | 3,800                                    | 530                | 0.057~0.096                     | 3,000   | 380                | 0.051~0.086                     | 2,200  | 240                | 0.04~0.067                      | 1,600                                      | 150                | 0.028~0.048                     |
|               |                       | 40                    | 3,800                              | 630                | 0.057~0.115                     | 3,800                                    | 530                | 0.057~0.096                     | 3,000   | 380                | 0.051~0.086                     | 2,200  | 240                | 0.022~0.036                     | 1,600                                      | 150                | 0.028~0.048                     |
|               |                       | 50                    | 2,900                              | 460                | 0.031~0.062                     | 2,900                                    | 390                | 0.031~0.052                     | 2,400   | 280                | 0.028~0.047                     | 1,700  | 180                | 0.022~0.036                     | 1,600                                      | 140                | 0.015~0.026                     |
| 2060          | 6                     | 20                    | 3,300                              | 670                | 0.113~0.227                     | 3,300                                    | 560                | 0.113~0.189                     | 2,700   | 400                | 0.102~0.17                      | 2,000  | 260                | 0.079~0.132                     | 1,100                                      | 130                | 0.056~0.094                     |
|               |                       | 30                    | 3,300                              | 670                | 0.113~0.227                     | 3,300                                    | 560                | 0.113~0.189                     | 2,700   | 400                | 0.102~0.17                      | 2,000  | 260                | 0.079~0.132                     | 1,100                                      | 130                | 0.056~0.094                     |
|               |                       | 40                    | 2,800                              | 480                | 0.057~0.115                     | 2,800                                    | 400                | 0.057~0.096                     | 2,200   | 270                | 0.051~0.086                     | 1,500  | 170                | 0.04~0.067                      | 1,000                                      | 100                | 0.028~0.048                     |
|               |                       | 50                    | 2,100                              | 330                | 0.031~0.062                     | 2,100                                    | 280                | 0.031~0.052                     | 1,600   | 200                | 0.028~0.047                     | 1,100  | 120                | 0.022~0.036                     | 1,000                                      | 90                 | 0.015~0.026                     |
|               |                       | 60                    | 2,100                              | 330                | 0.031~0.062                     | 2,100                                    | 280                | 0.031~0.052                     | 1,600   | 200                | 0.028~0.047                     | 1,100  | 120                | 0.022~0.036                     | 1,000                                      | 90                 | 0.015~0.026                     |

## Slotting



D : Outside Diameter (mm)

## Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Recommend water soluble or oil coolant.
- Recommend oil coolant for Titanium Alloys and Heat Resistant Alloys.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.4 \sim \phi 6$

**DCLS**

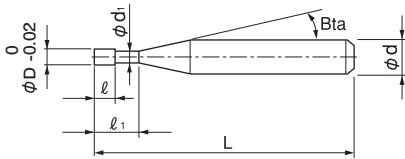


Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

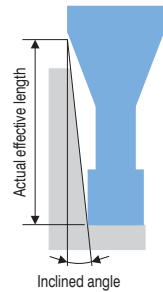
| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           | ○               | ★        | ○      | ○        | ●                     |                 |                       |                  | ○                                     |

**Features**

**2 Flute Diamond coated Long Neck Square End Mills for milling Graphite Electrodes.**  
 New diamond coating, with a highly adhesive base layer, offers excellent wear resistance and long tool life.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



Total 45 models

Unit (mm)

| Model Number  | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |        |       |       |
|---------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|--------|-------|-------|
|               |                           |                           |                      |                          |                       |                  |                         |                          | 30'                                 | 1°    | 1° 30' | 2°    | 3°    |
| DCLS 2004-020 | 0.4                       | 2                         | 0.8                  | 0.37                     | 16°                   | 45               | 4                       | 16,000                   | 2.26                                | 2.43  | 2.57   | 2.68  | 2.89  |
| DCLS 2004-040 |                           | 4                         |                      |                          |                       |                  |                         |                          | 4.40                                | 4.63  | 4.80   | 4.97  | 5.34  |
| DCLS 2004-060 |                           | 6                         |                      |                          |                       |                  |                         |                          | 6.51                                | 6.77  | 7.00   | 7.24  | 7.79  |
| DCLS 2005-020 | 0.5                       | 2                         | 1                    | 0.47                     | 16°                   | 45               | 4                       | 16,000                   | 2.32                                | 2.52  | 2.68   | 2.82  | 3.07  |
| DCLS 2005-040 |                           | 4                         |                      |                          |                       |                  |                         |                          | 4.48                                | 4.74  | 4.95   | 5.13  | 5.51  |
| DCLS 2005-060 |                           | 6                         |                      |                          |                       |                  |                         |                          | 6.60                                | 6.91  | 7.15   | 7.40  | 7.96  |
| DCLS 2006-020 | 0.6                       | 2                         | 1.2                  | 0.57                     | 16°                   | 45               | 4                       | 16,000                   | 2.36                                | 2.60  | 2.78   | 2.95  | 3.23  |
| DCLS 2006-040 |                           | 4                         |                      |                          |                       |                  |                         |                          | 4.55                                | 4.85  | 5.08   | 5.29  | 5.68  |
| DCLS 2006-060 |                           | 6                         |                      |                          |                       |                  |                         |                          | 6.69                                | 7.04  | 7.31   | 7.56  | 8.13  |
| DCLS 2006-080 |                           | 8                         |                      |                          |                       |                  |                         |                          | 8.80                                | 9.19  | 9.51   | 9.84  | 10.58 |
| DCLS 2006-100 |                           | 10                        |                      |                          |                       | 45               | 4                       | 16,000                   | 10.90                               | 11.33 | 11.71  | 12.12 | 13.03 |

Unit (mm)

| Model Number  | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|---------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|               |                           |                           |                      |                          |                       |                  |                         |                          | 30°                                 | 1°              | 1° 30'          | 2°              | 3°              |
| DCLS 2007-040 | 0.7                       | 4                         | 1.4                  | 0.67                     | 16°                   | 45               | 4                       | 16,000                   | 4.55                                | 4.85            | 5.08            | 5.29            | 5.68            |
| DCLS 2007-060 |                           | 6                         |                      |                          |                       | 45               | 4                       | 16,000                   | 6.69                                | 7.04            | 7.31            | 7.56            | 8.13            |
| DCLS 2007-080 |                           | 8                         |                      |                          |                       | 45               | 4                       | 16,000                   | 8.80                                | 9.19            | 9.51            | 9.84            | 10.58           |
| DCLS 2007-100 |                           | 10                        |                      |                          |                       | 45               | 4                       | 16,000                   | 10.90                               | 11.33           | 11.71           | 12.12           | 13.03           |
| DCLS 2008-040 | 0.8                       | 4                         | 1.6                  | 0.77                     | 16°                   | 45               | 4                       | 16,000                   | 4.55                                | 4.85            | 5.08            | 5.29            | 5.68            |
| DCLS 2008-060 |                           | 6                         |                      |                          |                       | 45               | 4                       | 16,000                   | 6.69                                | 7.04            | 7.31            | 7.56            | 8.13            |
| DCLS 2008-080 |                           | 8                         |                      |                          |                       | 45               | 4                       | 16,000                   | 8.80                                | 9.19            | 9.51            | 9.84            | 10.58           |
| DCLS 2008-100 |                           | 10                        |                      |                          |                       | 45               | 4                       | 16,000                   | 10.90                               | 11.33           | 11.71           | 12.12           | 13.03           |
| DCLS 2010-040 | 1                         | 4                         | 2                    | 0.96                     | 16°                   | 45               | 4                       | 16,000                   | 4.57                                | 4.86            | 5.09            | 5.30            | 5.70            |
| DCLS 2010-060 |                           | 6                         |                      |                          |                       | 45               | 4                       | 16,000                   | 6.70                                | 7.05            | 7.32            | 7.57            | 8.14            |
| DCLS 2010-080 |                           | 8                         |                      |                          |                       | 45               | 4                       | 16,000                   | 8.82                                | 9.20            | 9.52            | 9.85            | 10.59           |
| DCLS 2010-100 |                           | 10                        |                      |                          |                       | 45               | 4                       | 16,000                   | 10.91                               | 11.34           | 11.72           | 12.13           | 13.04           |
| DCLS 2010-160 |                           | 16                        |                      |                          |                       | 50               | 4                       | 16,000                   | 17.16                               | 17.73           | 18.32           | 18.96           | 20.38           |
| DCLS 2010-210 |                           | 21                        |                      |                          |                       | 55               | 4                       | 16,000                   | 22.33                               | 23.05           | 23.82           | 24.65           | 26.50           |
| DCLS 2015-060 | 1.5                       | 6                         | 3                    | 1.44                     | 16°                   | 45               | 4                       | 16,000                   | 6.17                                | 6.37            | 6.58            | 6.81            | 7.33            |
| DCLS 2015-100 |                           | 10                        |                      |                          |                       | 45               | 4                       | 16,000                   | 10.29                               | 10.63           | 10.98           | 11.37           | 12.22           |
| DCLS 2015-160 |                           | 16                        |                      |                          |                       | 50               | 4                       | 16,000                   | 16.48                               | 17.02           | 17.59           | 18.20           | 19.56           |
| DCLS 2015-210 |                           | 21                        |                      |                          |                       | 55               | 4                       | 16,000                   | 21.64                               | 22.34           | 23.09           | 23.89           | No Interference |
| DCLS 2020-060 | 2                         | 6                         | 4                    | 1.9                      | 16°                   | 50               | 4                       | 16,000                   | 6.22                                | 6.42            | 6.64            | 6.87            | 7.39            |
| DCLS 2020-100 |                           | 10                        |                      |                          |                       | 50               | 4                       | 16,000                   | 10.35                               | 10.68           | 11.04           | 11.43           | 12.28           |
| DCLS 2020-160 |                           | 16                        |                      |                          |                       | 50               | 4                       | 16,000                   | 16.53                               | 17.07           | 17.65           | 18.26           | No Interference |
| DCLS 2020-210 |                           | 21                        |                      |                          |                       | 55               | 4                       | 16,000                   | 21.69                               | 22.40           | 23.15           | 23.95           | No Interference |
| DCLS 2020-260 |                           | 26                        |                      |                          |                       | 55               | 4                       | 16,000                   | 26.85                               | 27.72           | 28.65           | No Interference | No Interference |
| DCLS 2030-160 | 3                         | 16                        | 6                    | 2.9                      | 16°                   | 70               | 6                       | 18,000                   | 16.53                               | 17.07           | 17.65           | 18.26           | 19.63           |
| DCLS 2030-210 |                           | 21                        |                      |                          |                       | 70               | 6                       | 20,000                   | 21.69                               | 22.40           | 23.15           | 23.95           | 25.74           |
| DCLS 2030-260 |                           | 26                        |                      |                          |                       | 70               | 6                       | 20,000                   | 26.85                               | 27.72           | 28.65           | 29.65           | No Interference |
| DCLS 2030-320 |                           | 32                        |                      |                          |                       | 80               | 6                       | 20,000                   | 33.04                               | 34.11           | 35.25           | 36.48           | No Interference |
| DCLS 2040-210 | 4                         | 21                        | 8                    | 3.91                     | 16°                   | 70               | 6                       | 20,000                   | 21.68                               | 22.39           | 23.14           | 23.94           | No Interference |
| DCLS 2040-260 |                           | 26                        |                      |                          |                       | 70               | 6                       | 20,000                   | 26.84                               | 27.71           | 28.64           | No Interference | No Interference |
| DCLS 2040-320 |                           | 32                        |                      |                          |                       | 70               | 6                       | 20,000                   | 33.03                               | 34.10           | 35.24           | No Interference | No Interference |
| DCLS 2040-420 |                           | 42                        |                      |                          |                       | 80               | 6                       | 23,000                   | 43.34                               | 44.75           | No Interference | No Interference | No Interference |
| DCLS 2060-320 | 6                         | 32                        | 12                   | 5.71                     | —                     | 80               | 6                       | 23,000                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| DCLS 2060-420 |                           | 42                        |                      |                          |                       | 80               | 6                       | 23,000                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| DCLS 2060-630 |                           | 63                        |                      |                          |                       | 120              | 6                       | 30,000                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank Ball  
Long Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for DCLS

| WORK MATERIAL |                       |                       | GRAPHITE                           |                    |                                 |                                  |                                 |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|---------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Side Milling                    |                                  | Slotting                        |
|               |                       |                       |                                    |                    | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | a <sub>p</sub> Axial Depth (mm) |
| 2004-020      | 0.4                   | 2                     | 34,000                             | 410                | 0.4                             | 0.02                             | 0.02                            |
| 2004-040      |                       | 4                     | 34,000                             | 240                | 0.4                             | 0.02                             | 0.02                            |
| 2004-060      |                       | 6                     | 34,000                             | 180                | 0.4                             | 0.02                             | 0.02                            |
| 2005-020      | 0.5                   | 2                     | 34,000                             | 540                | 0.5                             | 0.025                            | 0.025                           |
| 2005-040      |                       | 4                     | 34,000                             | 350                | 0.5                             | 0.025                            | 0.025                           |
| 2005-060      |                       | 6                     | 34,000                             | 240                | 0.5                             | 0.025                            | 0.025                           |
| 2006-020      | 0.6                   | 2                     | 34,000                             | 660                | 0.6                             | 0.03                             | 0.03                            |
| 2006-040      |                       | 4                     | 34,000                             | 520                | 0.6                             | 0.03                             | 0.03                            |
| 2006-060      |                       | 6                     | 34,000                             | 320                | 0.6                             | 0.03                             | 0.03                            |
| 2006-080      |                       | 8                     | 25,000                             | 220                | 0.6                             | 0.03                             | 0.03                            |
| 2006-100      | 0.7                   | 10                    | 24,000                             | 120                | 0.6                             | 0.03                             | 0.03                            |
| 2007-040      |                       | 4                     | 34,000                             | 600                | 0.7                             | 0.035                            | 0.035                           |
| 2007-060      |                       | 6                     | 34,000                             | 380                | 0.7                             | 0.035                            | 0.035                           |
| 2007-080      | 0.8                   | 8                     | 25,000                             | 260                | 0.7                             | 0.035                            | 0.035                           |
| 2007-100      |                       | 10                    | 24,000                             | 140                | 0.7                             | 0.035                            | 0.035                           |
| 2008-040      | 0.8                   | 4                     | 34,000                             | 690                | 0.8                             | 0.04                             | 0.04                            |
| 2008-060      |                       | 6                     | 34,000                             | 440                | 0.8                             | 0.04                             | 0.04                            |
| 2008-080      |                       | 8                     | 25,000                             | 300                | 0.8                             | 0.04                             | 0.04                            |
| 2008-100      |                       | 10                    | 24,000                             | 170                | 0.8                             | 0.04                             | 0.04                            |
| 2010-040      | 1                     | 4                     | 34,000                             | 1,170              | 1                               | 0.05                             | 0.1                             |
| 2010-060      |                       | 6                     | 26,000                             | 850                | 1                               | 0.05                             | 0.1                             |
| 2010-080      |                       | 8                     | 22,000                             | 660                | 1                               | 0.05                             | 0.1                             |
| 2010-100      |                       | 10                    | 22,100                             | 530                | 1                               | 0.05                             | 0.1                             |
| 2010-160      |                       | 16                    | 14,300                             | 300                | 1                               | 0.05                             | 0.1                             |
| 2010-210      |                       | 21                    | 12,500                             | 200                | 1                               | 0.05                             | 0.1                             |
| 2015-060      | 1.5                   | 6                     | 22,000                             | 1,620              | 1.5                             | 0.075                            | 0.15                            |
| 2015-100      |                       | 10                    | 17,000                             | 1,050              | 1.5                             | 0.075                            | 0.15                            |
| 2015-160      |                       | 16                    | 15,000                             | 600                | 1.5                             | 0.075                            | 0.15                            |
| 2015-210      |                       | 21                    | 10,000                             | 370                | 1.5                             | 0.075                            | 0.15                            |
| 2020-060      | 2                     | 6                     | 25,500                             | 2,175              | 2                               | 0.1                              | 0.2                             |
| 2020-100      |                       | 10                    | 21,000                             | 1,680              | 2                               | 0.1                              | 0.2                             |
| 2020-160      |                       | 16                    | 19,500                             | 1,230              | 2                               | 0.1                              | 0.2                             |
| 2020-210      |                       | 21                    | 16,500                             | 750                | 2                               | 0.1                              | 0.2                             |
| 2020-260      |                       | 26                    | 12,000                             | 590                | 2                               | 0.1                              | 0.2                             |
| 2030-160      | 3                     | 16                    | 22,000                             | 2,200              | 3                               | 0.15                             | 0.3                             |
| 2030-210      |                       | 21                    | 20,000                             | 1,800              | 3                               | 0.15                             | 0.3                             |
| 2030-260      |                       | 26                    | 18,000                             | 1,450              | 3                               | 0.15                             | 0.3                             |
| 2030-320      |                       | 32                    | 15,000                             | 1,040              | 3                               | 0.15                             | 0.3                             |
| 2040-210      | 4                     | 21                    | 14,000                             | 1,760              | 4                               | 0.2                              | 0.4                             |
| 2040-260      |                       | 26                    | 13,500                             | 1,450              | 4                               | 0.2                              | 0.4                             |
| 2040-320      |                       | 32                    | 13,000                             | 1,160              | 4                               | 0.2                              | 0.4                             |
| 2040-420      |                       | 42                    | 11,000                             | 900                | 4                               | 0.2                              | 0.4                             |
| 2060-320      | 6                     | 32                    | 12,000                             | 1,500              | 6                               | 0.6                              | 1.2                             |
| 2060-420      |                       | 42                    | 10,800                             | 1,160              | 6                               | 0.6                              | 1.2                             |
| 2060-630      |                       | 63                    | 7,400                              | 620                | 6                               | 0.6                              | 1.2                             |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball  
Taper Neck Ball

Taper

Barrel

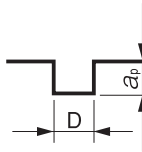
Spiral V Cutter

Drill

Technical Data

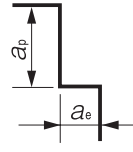


Slotting



D : Outside Diameter (mm)

Side Milling



## Note:

- Use a milling machine dedicated for Graphite.
- Recommend air blow for Graphite.

## Other series for Graphite milling

## Square / Long Neck Square

(★ Highly Recommended ● Recommended ○ Suggested)

| Number of Flutes,<br>Tool Type | Model<br>Number | Appearance | Coating  | Size                   | Aluminum<br>Alloys | Graphite | Copper | Plastics | Glass<br>Filled<br>Plastics | Hard Brittle<br>(Non-Metallic)<br>Materials | Page |
|--------------------------------|-----------------|------------|----------|------------------------|--------------------|----------|--------|----------|-----------------------------|---|------|
| 4 flutes Square                | CGE             |            | Non-coat | $\phi 2 \sim \phi 20$  | ○                  | ★        | ○      | ○        | ○                           |   | 236  |
| 2 flutes Square                | DCES 2000       |            | DIA      | $\phi 0.2 \sim \phi 6$ | ○                  | ★        | ○      | ○        | ●                           | ○   | 188  |
| 4 flutes Square                | DCES 4000       |            | DIA      | $\phi 3 \sim \phi 10$  | ○                  | ★        | ○      | ○        | ●                           | ○   | 234  |
| 2 flutes<br>Long Neck Square   | DCLS            |            | DIA      | $\phi 0.4 \sim \phi 6$ | ○                  | ★        | ○      | ○        | ●                           | ○   | 266  |

## Long Neck Radius

|                              |       |  |     |                      |   |   |   |   |   |   |     |
|------------------------------|-------|--|-----|----------------------|---|---|---|---|---|---|-----|
| 4 flutes<br>Long Neck Radius | DCLRS |  | DIA | $\phi 1 \sim \phi 6$ | ○ | ★ | ○ | ○ | ● | ○ | 396 |
|------------------------------|-------|--|-----|----------------------|---|---|---|---|---|---|-----|

## Ball / Long Neck Ball / Taper Neck Ball

|                             |          |  |          |         |   |   |   |   |   |   |     |
|-----------------------------|----------|--|----------|---------|---|---|---|---|---|---|-----|
| 2 flutes Ball               | CGB 2000 |  | Non-coat | R0.2~R6 | ○ | ★ | ○ | ○ | ○ |   | 440 |
| 4 flutes Ball               | CGB 4000 |  | Non-coat | R2~R10  | ○ | ★ | ○ | ○ | ○ |   | 458 |
| 2 flutes Ball               | DCB      |  | DIA      | R0.5~R6 | ○ | ★ | ○ | ○ | ● | ○ | 438 |
| 2 flutes<br>Long Neck Ball  | DCLB     |  | DIA      | R0.2~R3 | ○ | ★ | ○ | ○ | ● | ○ | 512 |
| 2 flutes<br>Taper Neck Ball | DCTNB    |  | DIA      | R0.5~R1 | ○ | ★ | ○ | ○ | ● | ○ | 556 |

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.5 \sim \phi 6$

**CPR**



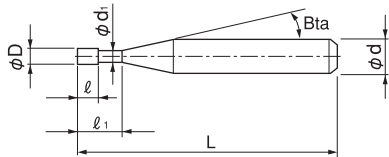
( $\phi 0.5 \sim \phi 2.5$ ) ( $\phi 3$  or above)

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           |                 |          | ○      | ●        | ★                     |                 |                       |                  |                                       |

**Features**

Long Neck Square End Mills for milling Plastics.  
Designed especially for deep rib milling using an under cut design.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 64 models

Unit (mm)

| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| CPR 2005-2   | 0.5                       | 2                         | 1                    | 0.45                     | 11°                   | 38               | 3                       | 6,700                    |
| CPR 2005-4   |                           | 4                         |                      |                          |                       | 38               | 3                       | 6,700                    |
| CPR 2005-6   |                           | 6                         |                      |                          |                       | 38               | 3                       | 6,700                    |
| CPR 2006-4   | 0.6                       | 4                         | 1.2                  | 0.55                     | 11°                   | 38               | 3                       | 6,000                    |
| CPR 2006-6   |                           | 6                         |                      |                          |                       | 38               | 3                       | 6,000                    |
| CPR 2007-4   | 0.7                       | 4                         | 1.4                  | 0.65                     | 11°                   | 38               | 3                       | 6,100                    |
| CPR 2007-6   |                           | 6                         |                      |                          |                       | 38               | 3                       | 6,100                    |
| CPR 2008-6   | 0.8                       | 6                         | 1.6                  | 0.75                     | 11°                   | 45               | 4                       | 5,100                    |
| CPR 2008-8   |                           | 8                         |                      |                          |                       | 45               | 4                       | 5,100                    |
| CPR 2009-6   | 0.9                       | 6                         | 1.8                  | 0.85                     | 11°                   | 45               | 4                       | 5,100                    |
| CPR 2009-10  |                           | 10                        |                      |                          |                       | 45               | 4                       | 5,100                    |
| CPR 2010-6   | 1                         | 6                         | 2                    | 0.9                      | 11°                   | 45               | 4                       | 5,040                    |
| CPR 2010-8   |                           | 8                         |                      |                          |                       | 45               | 4                       | 5,040                    |
| CPR 2010-10  |                           | 10                        |                      |                          |                       | 45               | 4                       | 5,040                    |
| CPR 2010-12  |                           | 12                        |                      |                          |                       | 45               | 4                       | 5,040                    |
| CPR 2010-16  |                           | 16                        |                      |                          |                       | 50               | 4                       | 5,040                    |
| CPR 2010-21  |                           | 21                        |                      |                          |                       | 55               | 4                       | 6,000                    |
| CPR 2012-6   | 1.2                       | 6                         | 2.4                  | 1.1                      | 11°                   | 45               | 4                       | 5,100                    |
| CPR 2012-8   |                           | 8                         |                      |                          |                       | 45               | 4                       | 5,100                    |
| CPR 2012-10  |                           | 10                        |                      |                          |                       | 45               | 4                       | 5,100                    |
| CPR 2012-12  |                           | 12                        |                      |                          |                       | 50               | 4                       | 5,100                    |

Unit (mm)

| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| CPR 2014-6   | 1.4                       | 6                         | 2.8                  | 1.3                      | 11°                   | 45               | 4                       | 5,100                    |
| CPR 2014-10  |                           | 10                        |                      |                          |                       | 45               | 4                       | 5,100                    |
| CPR 2014-16  |                           | 16                        |                      |                          |                       | 50               | 4                       | 5,100                    |
| CPR 2015-6   | 1.5                       | 6                         | 3                    | 1.4                      | 11°                   | 45               | 4                       | 5,100                    |
| CPR 2015-10  |                           | 10                        |                      |                          |                       | 45               | 4                       | 5,100                    |
| CPR 2015-14  |                           | 14                        |                      |                          |                       | 50               | 4                       | 5,100                    |
| CPR 2015-16  |                           | 16                        |                      |                          |                       | 50               | 4                       | 5,100                    |
| CPR 2015-21  |                           | 21                        |                      |                          |                       | 55               | 4                       | 5,100                    |
| CPR 2016-6   | 1.6                       | 6                         | 3.2                  | 1.5                      | 11°                   | 50               | 4                       | 5,100                    |
| CPR 2020-8   | 2                         | 8                         | 4                    | 1.9                      | 11°                   | 50               | 4                       | 5,040                    |
| CPR 2020-10  |                           | 10                        |                      |                          |                       | 50               | 4                       | 5,040                    |
| CPR 2020-12  |                           | 12                        |                      |                          |                       | 50               | 4                       | 5,040                    |
| CPR 2020-14  |                           | 14                        |                      |                          |                       | 50               | 4                       | 5,040                    |
| CPR 2020-16  |                           | 16                        |                      |                          |                       | 50               | 4                       | 5,040                    |
| CPR 2020-18  |                           | 18                        |                      |                          |                       | 55               | 4                       | 5,040                    |
| CPR 2020-21  |                           | 21                        |                      |                          |                       | 55               | 4                       | 5,040                    |
| CPR 2020-26  |                           | 26                        |                      |                          |                       | 55               | 4                       | 5,100                    |
| CPR 2020-32  |                           | 32                        |                      |                          |                       | 70               | 4                       | 6,100                    |
| CPR 2025-12  |                           | 2.5                       |                      |                          |                       | 12               | 5                       | 2.3                      |
| CPR 2025-21  | 21                        |                           | 55                   | 4                        | 5,600                 |                  |                         |                          |
| CPR 2030-8   | 3                         | 8                         | 6                    | 2.8                      | 11°                   | 70               | 6                       | 6,510                    |
| CPR 2030-12  |                           | 12                        |                      |                          |                       | 70               | 6                       | 6,510                    |
| CPR 2030-16  |                           | 16                        |                      |                          |                       | 70               | 6                       | 6,510                    |
| CPR 2030-21  |                           | 21                        |                      |                          |                       | 70               | 6                       | 6,510                    |
| CPR 2030-26  |                           | 26                        |                      |                          |                       | 70               | 6                       | 6,510                    |
| CPR 2030-32  |                           | 32                        |                      |                          |                       | 80               | 6                       | 7,200                    |
| CPR 2030-42  |                           | 42                        |                      |                          |                       | 90               | 6                       | 8,400                    |
| CPR 2040-12  |                           | 4                         |                      |                          |                       | 12               | 8                       | 3.8                      |
| CPR 2040-16  | 16                        |                           | 70                   | 6                        | 6,930                 |                  |                         |                          |
| CPR 2040-18  | 18                        |                           | 70                   | 6                        | 6,930                 |                  |                         |                          |
| CPR 2040-21  | 21                        |                           | 70                   | 6                        | 6,930                 |                  |                         |                          |
| CPR 2040-24  | 24                        |                           | 70                   | 6                        | 6,930                 |                  |                         |                          |
| CPR 2040-32  | 32                        |                           | 70                   | 6                        | 6,930                 |                  |                         |                          |
| CPR 2040-36  | 36                        |                           | 70                   | 6                        | 6,930                 |                  |                         |                          |
| CPR 2040-42  | 42                        |                           | 80                   | 6                        | 7,250                 |                  |                         |                          |
| CPR 2040-52  | 52                        |                           | 100                  | 6                        | 9,350                 |                  |                         |                          |
| CPR 2050-16  | 5                         |                           | 16                   | 10                       | 4.8                   | 11°              |                         |                          |
| CPR 2050-22  |                           | 22                        | 80                   |                          |                       |                  | 6                       | 7,980                    |
| CPR 2050-32  |                           | 32                        | 80                   |                          |                       |                  | 6                       | 7,980                    |
| CPR 2060-12  | 6                         | No Under Cut              | 12                   | No Under Cut             | —                     | 80               | 6                       | 7,670                    |
| CPR 2060-42  |                           | 42                        |                      | 5.8                      |                       | 80               | 6                       | 7,980                    |
| CPR 2060-52  |                           | 52                        |                      |                          |                       | 120              | 6                       | 11,030                   |
| CPR 2060-63  |                           | 63                        |                      | 120                      |                       | 6                | 11,030                  |                          |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for CPR

| WORK MATERIAL |                       |                       | ABS / MC NYLON                     |                    |                                 | ACRYLIC / POLYACETAL               |                    |                                 | POLYCARBONATE                      |                    |                                 | GLASS FIBER REINFORCED POLYCARBONATE |                    |                                 |     |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|---------------------------------|------------------------------------|--------------------|---------------------------------|------------------------------------|--------------------|---------------------------------|--------------------------------------|--------------------|---------------------------------|-----|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |     |
| 2005-2        | 0.5                   | 2                     | 6,000                              | 300                | 0.2                             | 15,000                             | 300                | 0.2                             | 9,000                              | 300                | 0.2                             | 9,000                                | 450                | 0.2                             |     |
|               |                       | 2005-4                | 4                                  | 6,000              | 300                             | 0.2                                | 15,000             | 300                             | 0.2                                | 9,000              | 300                             | 0.2                                  | 9,000              | 450                             | 0.2 |
|               |                       | 2005-6                | 6                                  | 6,000              | 300                             | 0.2                                | 15,000             | 300                             | 0.2                                | 9,000              | 300                             | 0.2                                  | 9,000              | 450                             | 0.2 |
| 2006-4        | 0.6                   | 4                     | 6,000                              | 340                | 0.2                             | 14,400                             | 300                | 0.2                             | 8,800                              | 540                | 0.2                             | 8,800                                | 810                | 0.2                             |     |
|               |                       | 2006-6                | 6                                  | 6,000              | 340                             | 0.2                                | 14,400             | 300                             | 0.2                                | 8,800              | 540                             | 0.2                                  | 8,800              | 810                             | 0.2 |
| 2007-4        | 0.7                   | 4                     | 6,000                              | 380                | 0.2                             | 13,800                             | 300                | 0.2                             | 8,600                              | 780                | 0.2                             | 8,600                                | 1,170              | 0.2                             |     |
|               |                       | 2007-6                | 6                                  | 6,000              | 380                             | 0.2                                | 13,800             | 300                             | 0.2                                | 8,600              | 780                             | 0.2                                  | 8,600              | 1,170                           | 0.2 |
| 2008-6        | 0.8                   | 6                     | 6,000                              | 420                | 0.2                             | 13,200                             | 300                | 0.2                             | 8,400                              | 1,000              | 0.2                             | 8,400                                | 1,500              | 0.2                             |     |
|               |                       | 2008-8                | 8                                  | 6,000              | 420                             | 0.2                                | 12,900             | 280                             | 0.2                                | 8,200              | 960                             | 0.2                                  | 8,200              | 1,440                           | 0.2 |
| 2009-6        | 0.9                   | 6                     | 6,000                              | 460                | 0.2                             | 12,600                             | 300                | 0.2                             | 8,200                              | 1,300              | 0.2                             | 8,200                                | 1,950              | 0.2                             |     |
|               |                       | 2009-10               | 10                                 | 6,000              | 460                             | 0.2                                | 11,800             | 260                             | 0.2                                | 7,800              | 1,000                           | 0.2                                  | 7,800              | 1,500                           | 0.2 |
| 2010-6        | 1                     | 6                     | 6,000                              | 500                | 0.3                             | 12,000                             | 300                | 0.3                             | 8,000                              | 1,500              | 0.3                             | 8,000                                | 2,250              | 0.3                             |     |
|               |                       | 2010-8                | 8                                  | 6,000              | 500                             | 0.3                                | 11,500             | 270                             | 0.3                                | 7,700              | 1,400                           | 0.3                                  | 7,700              | 2,100                           | 0.3 |
|               |                       | 2010-10               | 10                                 | 6,000              | 500                             | 0.3                                | 11,000             | 240                             | 0.3                                | 7,500              | 1,200                           | 0.3                                  | 7,500              | 1,800                           | 0.3 |
|               |                       | 2010-12               | 12                                 | 6,000              | 500                             | 0.3                                | 10,400             | 220                             | 0.3                                | 7,200              | 1,100                           | 0.3                                  | 7,200              | 1,650                           | 0.3 |
|               |                       | 2010-16               | 16                                 | 6,000              | 500                             | 0.3                                | 9,300              | 160                             | 0.3                                | 6,700              | 830                             | 0.3                                  | 6,700              | 1,245                           | 0.3 |
|               |                       | 2010-21               | 21                                 | 6,000              | 500                             | 0.3                                | 8,000              | 90                              | 0.3                                | 6,000              | 500                             | 0.3                                  | 6,000              | 750                             | 0.3 |
| 2012-6        | 1.2                   | 6                     | 6,000                              | 610                | 0.4                             | 11,700                             | 330                | 0.4                             | 8,000                              | 1,500              | 0.4                             | 8,000                                | 2,250              | 0.4                             |     |
|               |                       | 2012-8                | 8                                  | 6,000              | 610                             | 0.4                                | 11,200             | 300                             | 0.4                                | 7,700              | 1,400                           | 0.4                                  | 7,700              | 2,100                           | 0.4 |
|               |                       | 2012-10               | 10                                 | 6,000              | 600                             | 0.4                                | 10,700             | 280                             | 0.4                                | 7,500              | 1,300                           | 0.4                                  | 7,500              | 1,950                           | 0.4 |
|               |                       | 2012-12               | 12                                 | 6,000              | 600                             | 0.4                                | 10,200             | 250                             | 0.4                                | 7,200              | 1,200                           | 0.4                                  | 7,200              | 1,800                           | 0.4 |
| 2014-6        | 1.4                   | 6                     | 6,000                              | 720                | 0.4                             | 11,340                             | 360                | 0.4                             | 8,000                              | 1,600              | 0.4                             | 8,000                                | 2,400              | 0.4                             |     |
|               |                       | 2014-10               | 10                                 | 6,000              | 700                             | 0.4                                | 10,700             | 310                             | 0.4                                | 7,700              | 1,400                           | 0.4                                  | 7,700              | 2,100                           | 0.4 |
|               |                       | 2014-16               | 16                                 | 6,000              | 680                             | 0.4                                | 9,800              | 230                             | 0.4                                | 7,200              | 1,000                           | 0.4                                  | 7,200              | 1,500                           | 0.4 |
| 2015-6        | 1.5                   | 6                     | 6,100                              | 780                | 0.5                             | 11,200                             | 380                | 0.5                             | 8,000                              | 1,600              | 0.5                             | 8,000                                | 1,700              | 0.5                             |     |
|               |                       | 2015-10               | 10                                 | 6,000              | 760                             | 0.5                                | 10,200             | 330                             | 0.5                                | 7,500              | 1,400                           | 0.5                                  | 7,500              | 1,600                           | 0.5 |
|               |                       | 2015-14               | 14                                 | 6,000              | 730                             | 0.5                                | 9,600              | 270                             | 0.5                                | 7,000              | 1,100                           | 0.5                                  | 7,000              | 1,400                           | 0.5 |
|               |                       | 2015-16               | 16                                 | 6,000              | 730                             | 0.5                                | 8,800              | 250                             | 0.5                                | 6,700              | 1,000                           | 0.5                                  | 6,700              | 1,400                           | 0.5 |
|               |                       | 2015-21               | 21                                 | 5,900              | 700                             | 0.5                                | 7,600              | 180                             | 0.5                                | 6,100              | 750                             | 0.5                                  | 6,100              | 1,200                           | 0.5 |
| 2016-6        | 1.6                   | 6                     | 6,100                              | 830                | 0.8                             | 11,000                             | 390                | 0.8                             | 8,000                              | 1,600              | 0.8                             | 8,000                                | 1,700              | 0.8                             |     |
|               |                       | 2020-8                | 8                                  | 6,100              | 1,000                           | 1                                  | 10,100             | 440                             | 1                                  | 7,900              | 1,700                           | 1                                    | 7,900              | 1,800                           | 1   |
|               |                       | 2020-10               | 10                                 | 6,000              | 980                             | 1                                  | 9,800              | 420                             | 1                                  | 7,700              | 1,600                           | 1                                    | 7,700              | 1,800                           | 1   |
|               |                       | 2020-12               | 12                                 | 6,000              | 970                             | 1                                  | 9,500              | 400                             | 1                                  | 7,500              | 1,600                           | 1                                    | 7,500              | 1,700                           | 1   |
| 2020-14       | 2                     | 14                    | 5,900                              | 950                | 1                               | 9,100                              | 380                | 1                               | 7,300                              | 1,500              | 1                               | 7,300                                | 1,700              | 1                               |     |
|               |                       | 2020-16               | 16                                 | 5,900              | 930                             | 1                                  | 8,800              | 360                             | 1                                  | 7,100              | 1,400                           | 1                                    | 7,100              | 1,600                           | 1   |
|               |                       | 2020-18               | 18                                 | 5,800              | 920                             | 1                                  | 8,500              | 340                             | 1                                  | 6,900              | 1,300                           | 1                                    | 6,900              | 1,600                           | 1   |
|               |                       | 2020-21               | 21                                 | 5,700              | 890                             | 1                                  | 8,000              | 300                             | 1                                  | 6,500              | 1,200                           | 1                                    | 6,500              | 1,500                           | 1   |
|               |                       | 2020-26               | 26                                 | 5,600              | 850                             | 1                                  | 7,200              | 250                             | 1                                  | 6,000              | 1,100                           | 1                                    | 6,000              | 1,400                           | 1   |
|               |                       | 2020-32               | 32                                 | 5,400              | 800                             | 1                                  | 6,200              | 190                             | 1                                  | 5,400              | 850                             | 1                                    | 5,400              | 1,300                           | 1   |
| 2025-12       | 2.5                   | 12                    | 6,000                              | 1,300              | 1.2                             | 8,600                              | 480                | 1.2                             | 7,400                              | 1,600              | 1.2                             | 7,400                                | 1,900              | 1.2                             |     |
|               |                       | 2025-21               | 21                                 | 5,700              | 1,100                           | 1                                  | 6,800              | 350                             | 1                                  | 6,200              | 1,300                           | 1                                    | 6,200              | 1,600                           | 1   |

ø3mm Shank V Series

UDC-PCD Series

CBN Series

Square Long Neck Square

Radius

Long Neck Radius Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

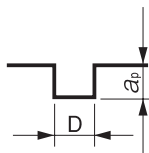
## Milling Conditions for CPR

| WORK MATERIAL |                       |                       | ABS / MC NYLON                     |                    |                        | ACRYLIC / POLYACETAL               |                    |                        | POLYCARBONATE                      |                    |                        | GLASS FIBER REINFORCED POLYCARBONATE |                    |                        |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|------------------------|------------------------------------|--------------------|------------------------|------------------------------------|--------------------|------------------------|--------------------------------------|--------------------|------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_D$ Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_D$ Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_D$ Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | $a_D$ Axial Depth (mm) |
| 2030-8        | 3                     | 8                     | 6,200                              | 1,600              | 1.5                    | 8,700                              | 610                | 1.5                    | 8,000                              | 1,900              | 1.5                    | 8,000                                | 2,200              | 1.5                    |
| 2030-12       |                       | 12                    | 6,000                              | 1,500              | 1.5                    | 8,000                              | 560                | 1.5                    | 7,500                              | 1,800              | 1.5                    | 7,500                                | 2,100              | 1.5                    |
| 2030-16       |                       | 16                    | 5,800                              | 1,400              | 1.5                    | 7,300                              | 510                | 1.5                    | 7,000                              | 1,700              | 1.5                    | 7,000                                | 2,000              | 1.5                    |
| 2030-21       |                       | 21                    | 5,600                              | 1,300              | 1.5                    | 6,400                              | 440                | 1.5                    | 6,300                              | 1,500              | 1.5                    | 6,300                                | 1,800              | 1.5                    |
| 2030-26       |                       | 26                    | 5,400                              | 1,200              | 1.5                    | 5,500                              | 370                | 1.5                    | 5,600                              | 1,400              | 1.5                    | 5,600                                | 1,700              | 1.5                    |
| 2030-32       |                       | 32                    | 5,200                              | 1,100              | 1.5                    | 4,500                              | 290                | 1.5                    | 4,800                              | 1,200              | 1.5                    | 4,800                                | 1,400              | 1.5                    |
| 2030-42       |                       | 42                    | 4,800                              | 960                | 1.5                    | 2,700                              | 160                | 1.5                    | 3,500                              | 840                | 1.5                    | 3,500                                | 1,000              | 1.5                    |
| 2040-12       | 4                     | 12                    | 5,000                              | 1,400              | 2                      | 7,000                              | 520                | 2                      | 5,800                              | 1,500              | 2                      | 5,800                                | 1,800              | 2                      |
| 2040-16       |                       | 16                    | 4,900                              | 1,400              | 2                      | 6,500                              | 480                | 2                      | 5,500                              | 1,400              | 2                      | 5,500                                | 1,700              | 2                      |
| 2040-18       |                       | 18                    | 4,800                              | 1,400              | 2                      | 6,300                              | 470                | 2                      | 5,400                              | 1,400              | 2                      | 5,400                                | 1,700              | 2                      |
| 2040-21       |                       | 21                    | 4,800                              | 1,400              | 2                      | 6,000                              | 440                | 2                      | 5,100                              | 1,300              | 2                      | 5,100                                | 1,600              | 2                      |
| 2040-24       |                       | 24                    | 4,700                              | 1,300              | 2                      | 5,600                              | 410                | 2                      | 4,900                              | 1,300              | 2                      | 4,900                                | 1,600              | 2                      |
| 2040-32       |                       | 32                    | 4,500                              | 1,300              | 2                      | 4,700                              | 340                | 2                      | 4,400                              | 1,100              | 2                      | 4,400                                | 1,500              | 2                      |
| 2040-36       |                       | 36                    | 4,300                              | 1,300              | 2                      | 4,200                              | 300                | 2                      | 4,100                              | 1,100              | 2                      | 4,100                                | 1,400              | 2                      |
| 2040-42       |                       | 42                    | 4,200                              | 1,300              | 2                      | 3,600                              | 250                | 2                      | 3,600                              | 960                | 2                      | 3,600                                | 1,200              | 2                      |
| 2040-52       | 52                    | 3,900                 | 1,200                              | 2                  | 2,400                  | 160                                | 2                  | 2,900                  | 780                                | 2                  | 2,900                  | 1,000                                | 2                  |                        |
| 2050-16       | 5                     | 16                    | 3,400                              | 1,200              | 2.5                    | 5,800                              | 470                | 2.5                    | 4,000                              | 1,200              | 2.5                    | 4,000                                | 1,400              | 2.5                    |
| 2050-22       |                       | 22                    | 3,300                              | 1,100              | 2.5                    | 5,100                              | 390                | 2.5                    | 3,600                              | 1,100              | 2.5                    | 3,600                                | 1,300              | 2.5                    |
| 2050-32       |                       | 32                    | 3,200                              | 1,100              | 2.5                    | 3,900                              | 260                | 2.5                    | 2,900                              | 910                | 2.5                    | 2,900                                | 1,100              | 2.5                    |
| 2060-12       | 6                     | 12                    | 3,000                              | 1,200              | 3                      | 5,000                              | 450                | 3                      | 2,500                              | 1,000              | 3                      | 2,500                                | 1,500              | 3                      |
| 2060-42       |                       | 42                    | 2,400                              | 960                | 3                      | 2,600                              | 240                | 3                      | 1,900                              | 760                | 3                      | 1,900                                | 1,140              | 3                      |
| 2060-52       |                       | 52                    | 2,200                              | 890                | 3                      | 1,900                              | 170                | 3                      | 1,700                              | 670                | 3                      | 1,700                                | 1,005              | 3                      |
| 2060-63       |                       | 63                    | 2,000                              | 800                | 3                      | 1,000                              | 90                 | 3                      | 1,500                              | 600                | 3                      | 1,500                                | 900                | 3                      |

## Milling Amount for Slotting (mm)

$$a_e \leq 0.5D$$

D : Outside Diameter (mm)



## CPR Finishing Conditions for Side Milling

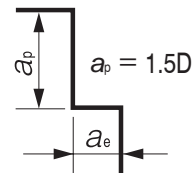
Refer to the slotting parameters for speeds and feeds.

Set the milling amount as below during side milling finishing.

## Milling Amount for Side Finishing (mm)

$$a_e : 0.01 \sim 0.015D \text{ (Min 0.01 mm)}$$

D : Outside Diameter (mm)



## Note:

- Control the radial depth (ae) by approximately 0.01-0.015 times of the outside diameter or set to 0.01 mm the minimum during side milling finishing.
- Increase the feed rate per flute to reduce burring on surface of softer materials.
- Chattering may occur when using a spindle with low rigidity or when milling unstable work piece. Reduce the milling amount in this case.
- Recommend to reduce the milling amount when using a machine with low spindle speed. Not recommend to reduce the feed rate.
- Recommend water soluble coolant for Copper and Aluminum Alloys.
- Recommend air blow for Plastics.
- Remove chips from the work piece to keep the milling surface quality.
- If chips clog on the tool, stop the operation and remove them accordingly.

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.5 \sim \phi 4$

# CPRL



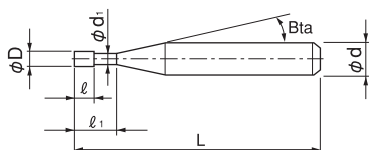
( $\phi 0.5 \sim \phi 2$ ) ( $\phi 3$  or above)

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           |                 |          | ○      | ●        | ★                     |                 |                       |                  |                                       |

## Features

Long Neck & Long Shank Square End Mills for milling Plastics.  
High performance for deep rib cut milling.  
Excellent cutting performance for milling Plastics.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 36 models

Unit (mm)

| Model Number | Outside Diameter $\phi D$ | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $Bta$ | Overall Length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|---------------------------|------------------------|-------------------|--------------------------|-------------------------|--------------------|-------------------------|--------------------------|
| CPRL 2005-4  | 0.5                       | 4                      | 1                 | 0.45                     | 11°                     | 80                 | 4                       | 8,000                    |
| CPRL 2005-6  |                           | 6                      |                   |                          |                         | 80                 | 4                       | 8,000                    |
| CPRL 2005-8  |                           | 8                      |                   |                          |                         | 80                 | 4                       | 9,000                    |
| CPRL 2005-10 |                           | 10                     |                   |                          |                         | 80                 | 4                       | 9,800                    |
| CPRL 2010-6  | 1                         | 6                      | 2                 | 0.9                      | 11°                     | 80                 | 4                       | 6,000                    |
| CPRL 2010-8  |                           | 8                      |                   |                          |                         | 80                 | 4                       | 6,000                    |
| CPRL 2010-10 |                           | 10                     |                   |                          |                         | 80                 | 4                       | 6,000                    |
| CPRL 2010-12 |                           | 12                     |                   |                          |                         | 80                 | 4                       | 6,000                    |
| CPRL 2010-14 |                           | 14                     |                   |                          |                         | 80                 | 4                       | 6,000                    |
| CPRL 2010-16 |                           | 16                     |                   |                          |                         | 80                 | 4                       | 6,000                    |
| CPRL 2010-18 |                           | 18                     |                   |                          |                         | 80                 | 4                       | 7,200                    |
| CPRL 2010-21 |                           | 21                     |                   |                          |                         | 80                 | 4                       | 7,800                    |
| CPRL 2015-6  | 1.5                       | 6                      | 3                 | 1.4                      | 11°                     | 80                 | 4                       | 6,000                    |
| CPRL 2015-8  |                           | 8                      |                   |                          |                         | 80                 | 4                       | 6,000                    |
| CPRL 2015-10 |                           | 10                     |                   |                          |                         | 80                 | 4                       | 6,000                    |
| CPRL 2015-14 |                           | 14                     |                   |                          |                         | 80                 | 4                       | 6,000                    |
| CPRL 2015-16 |                           | 16                     |                   |                          |                         | 80                 | 4                       | 6,000                    |
| CPRL 2015-21 |                           | 21                     |                   |                          |                         | 80                 | 4                       | 6,000                    |

Unit (mm)

| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| CPRL 2020-8  | 2                         | 8                         | 4                    | 1.9                      | 11°                   | 80               | 4                       | 6,000                    |
| CPRL 2020-10 |                           | 10                        |                      |                          |                       | 80               | 4                       | 6,000                    |
| CPRL 2020-12 |                           | 12                        |                      |                          |                       | 80               | 4                       | 6,000                    |
| CPRL 2020-14 |                           | 14                        |                      |                          |                       | 80               | 4                       | 6,000                    |
| CPRL 2020-16 |                           | 16                        |                      |                          |                       | 80               | 4                       | 6,000                    |
| CPRL 2020-18 |                           | 18                        |                      |                          |                       | 80               | 4                       | 6,000                    |
| CPRL 2020-21 |                           | 21                        |                      |                          |                       | 80               | 4                       | 6,000                    |
| CPRL 2020-26 |                           | 26                        |                      |                          |                       | 80               | 4                       | 6,000                    |
| CPRL 2020-32 |                           | 32                        |                      |                          |                       | 80               | 4                       | 6,000                    |
| CPRL 2020-40 |                           | 40                        |                      |                          |                       | 100              | 4                       | 9,400                    |
| CPRL 2030-12 | 3                         | 12                        | 6                    | 2.8                      | 11°                   | 100              | 6                       | 7,800                    |
| CPRL 2030-16 |                           | 16                        |                      |                          |                       | 100              | 6                       | 7,800                    |
| CPRL 2030-21 |                           | 21                        |                      |                          |                       | 100              | 6                       | 7,800                    |
| CPRL 2030-26 |                           | 26                        |                      |                          |                       | 100              | 6                       | 7,800                    |
| CPRL 2030-32 |                           | 32                        |                      |                          |                       | 100              | 6                       | 8,600                    |
| CPRL 2040-18 | 4                         | 18                        | 8                    | 3.8                      | 11°                   | 100              | 6                       | 8,300                    |
| CPRL 2040-24 |                           | 24                        |                      |                          |                       | 100              | 6                       | 8,300                    |
| CPRL 2040-32 |                           | 32                        |                      |                          |                       | 100              | 6                       | 8,300                    |

CPRL Series  
Acrylic  
Milling Video



Other series for Plastics milling

(★ Highly Recommended ● Recommended ○ Suggested)

| Number of Flutes, Tool Type          | Model Number | Appearance | Coating  | Size                    | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Hard Brittle (Non-Metallic) Materials | Page |
|--------------------------------------|--------------|------------|----------|-------------------------|-----------------|----------|--------|----------|-----------------------|---------------------------------------|------|
| 2 flutes Square                      | CPS          |            | Non-coat | $\phi 0.3 \sim \phi 12$ | ○               |          | ●      | ★        |                       |                                       | 190  |
| 2 flutes Long Neck Square            | CPR          |            | Non-coat | $\phi 0.5 \sim \phi 6$  | ○               |          | ●      | ★        |                       |                                       | 270  |
| 2 flutes Long Neck Long Shank Square | CPRL         |            | Non-coat | $\phi 0.5 \sim \phi 4$  | ○               |          | ●      | ★        |                       |                                       | 274  |
| 2 flutes Long Neck Ball              | CPRB         |            | Non-coat | R0.2~R3                 | ○               |          | ●      | ★        |                       |                                       | 526  |

※ Diamond coating series is recommended for Glass Filled Plastics and others abrasive plastics.

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball  
Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

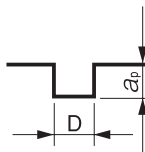
Drill

Technical Data

Milling Conditions for CPRL

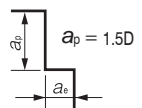
| Model Number | Outside Diameter (mm) | Effective Length (mm) | ABS / MC NYLON                     |                    |                                 |                                  | ACRYLIC / POLYACETAL               |                    |                                 |                                  | POLYCARBONATE                      |                    |                                 |                                  | GLASS FIBER REINFORCED POLYCARBONATE |                    |                                 |                                  |
|--------------|-----------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--------------------------------------|--------------------|---------------------------------|----------------------------------|
|              |                       |                       | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>0</sub> Axial Depth (mm) | a <sub>r</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>0</sub> Axial Depth (mm) | a <sub>r</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>0</sub> Axial Depth (mm) | a <sub>r</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>0</sub> Axial Depth (mm) | a <sub>r</sub> Radial Depth (mm) |
| 2005-4       | 0.5                   | 4                     | 6,000                              | 300                | 0.2                             | 0.5                              | 15,000                             | 300                | 0.2                             | 0.5                              | 9,000                              | 300                | 0.2                             | 0.5                              | 9,000                                | 90                 | 0.2                             | 0.5                              |
| 2005-6       |                       | 6                     | 6,000                              | 300                | 0.2                             | 0.5                              | 15,000                             | 300                | 0.2                             | 0.5                              | 9,000                              | 300                | 0.2                             | 0.5                              | 9,000                                | 90                 | 0.2                             | 0.5                              |
| 2005-8       |                       | 8                     | 6,000                              | 300                | 0.2                             | 0.5                              | 15,000                             | 300                | 0.2                             | 0.5                              | 9,000                              | 300                | 0.2                             | 0.5                              | 9,000                                | 90                 | 0.2                             | 0.5                              |
| 2005-10      |                       | 10                    | 6,000                              | 300                | 0.2                             | 0.5                              | 15,000                             | 300                | 0.2                             | 0.5                              | 9,000                              | 300                | 0.2                             | 0.5                              | 9,000                                | 90                 | 0.2                             | 0.5                              |
| 2010-6       |                       | 6                     | 6,000                              | 500                | 0.3                             | 1                                | 12,000                             | 300                | 0.3                             | 1                                | 8,000                              | 1,500              | 0.3                             | 1                                | 8,000                                | 1,500              | 0.3                             | 1                                |
| 2010-8       | 8                     | 6,000                 | 500                                | 0.3                | 1                               | 11,500                           | 270                                | 0.3                | 1                               | 7,700                            | 1,400                              | 0.3                | 1                               | 7,700                            | 1,400                                | 0.3                | 1                               |                                  |
| 2010-10      | 10                    | 6,000                 | 500                                | 0.3                | 1                               | 11,000                           | 240                                | 0.3                | 1                               | 7,500                            | 1,200                              | 0.3                | 1                               | 7,500                            | 1,400                                | 0.3                | 1                               |                                  |
| 2010-12      | 12                    | 6,000                 | 500                                | 0.3                | 1                               | 10,400                           | 220                                | 0.3                | 1                               | 7,200                            | 1,100                              | 0.3                | 1                               | 7,200                            | 1,300                                | 0.3                | 1                               |                                  |
| 2010-14      | 14                    | 6,000                 | 500                                | 0.3                | 1                               | 9,900                            | 190                                | 0.3                | 1                               | 6,900                            | 970                                | 0.3                | 1                               | 6,900                            | 1,200                                | 0.3                | 1                               |                                  |
| 2010-16      | 16                    | 6,000                 | 500                                | 0.3                | 1                               | 9,300                            | 160                                | 0.3                | 1                               | 6,700                            | 830                                | 0.3                | 1                               | 6,700                            | 1,200                                | 0.3                | 1                               |                                  |
| 2010-18      | 18                    | 6,000                 | 500                                | 0.3                | 1                               | 8,800                            | 130                                | 0.3                | 1                               | 6,400                            | 700                                | 0.3                | 1                               | 6,400                            | 1,100                                | 0.3                | 1                               |                                  |
| 2010-21      | 21                    | 6,000                 | 500                                | 0.3                | 1                               | 8,000                            | 90                                 | 0.3                | 1                               | 6,000                            | 500                                | 0.3                | 1                               | 6,000                            | 1,000                                | 0.3                | 1                               |                                  |
| 2015-6       | 1.5                   | 6                     | 6,100                              | 780                | 0.5                             | 1.5                              | 11,200                             | 380                | 0.5                             | 1.5                              | 8,000                              | 1,600              | 0.5                             | 1.5                              | 8,000                                | 1,700              | 0.5                             | 1.5                              |
| 2015-8       |                       | 8                     | 6,100                              | 770                | 0.5                             | 1.5                              | 10,700                             | 350                | 0.5                             | 1.5                              | 7,700                              | 1,500              | 0.5                             | 1.5                              | 7,700                                | 1,600              | 0.5                             | 1.5                              |
| 2015-10      |                       | 10                    | 6,000                              | 760                | 0.5                             | 1.5                              | 10,200                             | 330                | 0.5                             | 1.5                              | 7,500                              | 1,400              | 0.5                             | 1.5                              | 7,500                                | 1,600              | 0.5                             | 1.5                              |
| 2015-14      |                       | 14                    | 6,000                              | 730                | 0.5                             | 1.5                              | 9,600                              | 270                | 0.5                             | 1.5                              | 7,000                              | 1,100              | 0.5                             | 1.5                              | 7,000                                | 1,400              | 0.5                             | 1.5                              |
| 2015-16      |                       | 16                    | 6,000                              | 730                | 0.5                             | 1.5                              | 8,800                              | 250                | 0.5                             | 1.5                              | 6,700                              | 1,000              | 0.5                             | 1.5                              | 6,700                                | 1,400              | 0.5                             | 1.5                              |
| 2015-21      |                       | 21                    | 5,900                              | 700                | 0.5                             | 1.5                              | 7,600                              | 180                | 0.5                             | 1.5                              | 6,100                              | 750                | 0.5                             | 1.5                              | 6,100                                | 1,200              | 0.5                             | 1.5                              |
| 2020-8       | 2                     | 8                     | 6,100                              | 1,000              | 1                               | 2                                | 10,100                             | 440                | 1                               | 2                                | 7,900                              | 1,700              | 1                               | 2                                | 7,900                                | 1,800              | 1                               | 2                                |
| 2020-10      |                       | 10                    | 6,000                              | 980                | 1                               | 2                                | 9,800                              | 420                | 1                               | 2                                | 7,700                              | 1,600              | 1                               | 2                                | 7,700                                | 1,800              | 1                               | 2                                |
| 2020-12      |                       | 12                    | 6,000                              | 970                | 1                               | 2                                | 9,500                              | 400                | 1                               | 2                                | 7,500                              | 1,600              | 1                               | 2                                | 7,500                                | 1,700              | 1                               | 2                                |
| 2020-14      |                       | 14                    | 5,900                              | 950                | 1                               | 2                                | 9,100                              | 380                | 1                               | 2                                | 7,300                              | 1,500              | 1                               | 2                                | 7,300                                | 1,700              | 1                               | 2                                |
| 2020-16      |                       | 16                    | 5,900                              | 930                | 1                               | 2                                | 8,800                              | 360                | 1                               | 2                                | 7,100                              | 1,400              | 1                               | 2                                | 7,100                                | 1,600              | 1                               | 2                                |
| 2020-18      |                       | 18                    | 5,800                              | 920                | 1                               | 2                                | 8,500                              | 340                | 1                               | 2                                | 6,900                              | 1,300              | 1                               | 2                                | 6,900                                | 1,600              | 1                               | 2                                |
| 2020-21      |                       | 21                    | 5,700                              | 890                | 1                               | 2                                | 8,000                              | 300                | 1                               | 2                                | 6,500                              | 1,200              | 1                               | 2                                | 6,500                                | 1,500              | 1                               | 2                                |
| 2020-26      |                       | 26                    | 5,600                              | 850                | 1                               | 2                                | 7,200                              | 250                | 1                               | 2                                | 6,000                              | 1,100              | 1                               | 2                                | 6,000                                | 1,400              | 1                               | 2                                |
| 2020-32      |                       | 32                    | 5,400                              | 800                | 1                               | 2                                | 6,200                              | 190                | 1                               | 2                                | 5,400                              | 850                | 1                               | 2                                | 5,400                                | 1,300              | 1                               | 2                                |
| 2020-40      |                       | 40                    | 5,200                              | 730                | 1                               | 2                                | 4,900                              | 110                | 1                               | 2                                | 4,600                              | 570                | 1                               | 2                                | 4,600                                | 1,100              | 1                               | 2                                |
| 2030-12      | 3                     | 12                    | 6,000                              | 1,500              | 1.5                             | 3                                | 8,000                              | 560                | 1.5                             | 3                                | 7,500                              | 1,800              | 1.5                             | 3                                | 7,500                                | 2,100              | 1.5                             | 3                                |
| 2030-16      |                       | 16                    | 5,800                              | 1,400              | 1.5                             | 3                                | 7,300                              | 510                | 1.5                             | 3                                | 7,000                              | 1,700              | 1.5                             | 3                                | 7,000                                | 2,000              | 1.5                             | 3                                |
| 2030-21      |                       | 21                    | 5,600                              | 1,300              | 1.5                             | 3                                | 6,400                              | 440                | 1.5                             | 3                                | 6,300                              | 1,500              | 1.5                             | 3                                | 6,300                                | 1,800              | 1.5                             | 3                                |
| 2030-26      |                       | 26                    | 5,400                              | 1,200              | 1.5                             | 3                                | 5,500                              | 370                | 1.5                             | 3                                | 5,600                              | 1,400              | 1.5                             | 3                                | 5,600                                | 1,700              | 1.5                             | 3                                |
| 2030-32      |                       | 32                    | 5,200                              | 1,100              | 1.5                             | 3                                | 4,500                              | 290                | 1.5                             | 3                                | 4,800                              | 1,200              | 1.5                             | 3                                | 4,800                                | 1,400              | 1.5                             | 3                                |
| 2040-18      | 4                     | 18                    | 4,800                              | 1,400              | 2                               | 4                                | 6,300                              | 470                | 2                               | 4                                | 5,400                              | 1,400              | 2                               | 4                                | 5,400                                | 1,700              | 2                               | 4                                |
| 2040-24      |                       | 24                    | 4,700                              | 1,300              | 2                               | 4                                | 5,600                              | 410                | 2                               | 4                                | 4,900                              | 1,300              | 2                               | 4                                | 4,900                                | 1,600              | 2                               | 4                                |
| 2040-32      |                       | 32                    | 4,500                              | 1,300              | 2                               | 4                                | 4,700                              | 340                | 2                               | 4                                | 4,400                              | 1,100              | 2                               | 4                                | 4,400                                | 1,500              | 2                               | 4                                |

Milling Amount for Slotting (mm)  
 $a_p \leq 0.5D$   
 D : Outside Diameter (mm)



CPRL Finishing Conditions for Side Milling  
 Refer to the slotting parameters for speeds and feeds.  
 Set the milling amount as below during side milling finishing.

Milling Amount for Side Finishing (mm)  
 $a_e : 0.01 \sim 0.015D$  (Min 0.01 mm)  
 D : Outside Diameter (mm)





## Milling Conditions for CPRL

- Note:
- Control the radial depth ( $a_p$ ) by approximately 0.01-0.015 times of the outside diameter or set to 0.01 mm the minimum during side milling finishing.
  - Increase the feed per tooth to reduce burr on surface of softer materials.
  - Chattering may occur when using a spindle with low rigidity or when milling unstable work piece. Reduce the milling amount in this case.
  - Recommend to reduce the milling amount when using a machine with low spindle speed. Not recommend to reduce the feed rate.
  - Recommend water soluble coolant for Copper and Aluminum Alloys.
  - Recommend air blow for Plastics.
  - Remove chips from the work piece to keep the milling surface quality.
  - If chips clog on the tool, stop the operation and remove them accordingly.

### CPR $\phi 1 \times$ EL6 Slotting Example

MC Nylon

|             | Spindle speed (min <sup>-1</sup> ) | Feed rate (mm/min) | $a_p$ (mm) | Feed per tooth (mm/t) |
|-------------|------------------------------------|--------------------|------------|-----------------------|
| Condition 1 | 6,000                              | 400                | 0.3        | 0.033                 |
| Condition 2 | 6,000                              | 500                | 0.3        | 0.042                 |
| Condition 3 | 6,000                              | 600                | 0.3        | 0.05                  |

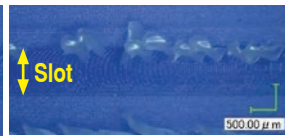
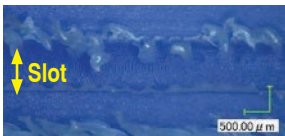


Best result

Condition 1 Vf : 400

Condition 2 Vf : 500

Condition 3 Vf : 600



### CPR $\phi 1 \times$ EL6 Slotting Example

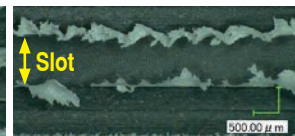
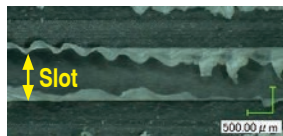
Polycarbonate

|             | Spindle speed (min <sup>-1</sup> ) | Feed rate (mm/min) | $a_p$ (mm) | Feed per tooth (mm/t) |
|-------------|------------------------------------|--------------------|------------|-----------------------|
| Condition 1 | 8,000                              | 100                | 0.3        | 0.006                 |
| Condition 2 | 8,000                              | 500                | 0.3        | 0.031                 |
| Condition 3 | 8,000                              | 1,000              | 0.3        | 0.063                 |
| Condition 4 | 8,000                              | 1,500              | 0.3        | 0.094                 |
| Condition 5 | 8,000                              | 2,000              | 0.3        | 0.125                 |

Best result

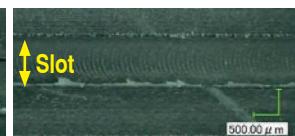
Condition 1 Vf : 100

Condition 2 Vf : 500



Condition 3 Vf : 1000

Condition 4 Vf : 1500



Condition 5 Vf : 2000



Workpiece quality is easily affected by minor differences in milling conditions. Testing several conditions is crucial for milling plastics.

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Ball  
Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 1 \sim \phi 12$

# AZS

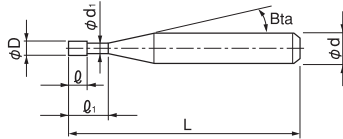


Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        | ★         |                 | ○        | ○      |          |                       |                 |                       |                  |                                       |

## Features

- Capable of verical milling into a flat surface.
- Achieves shorter processing time by removing pre-drilling or ramping cycle.
- 45° helix angle offers excellent chip evacuation.
- The flute shape is specifically designed for reducing burrs on Aluminum Alloys.
- The micro flatland design greatly helps control of chipping.

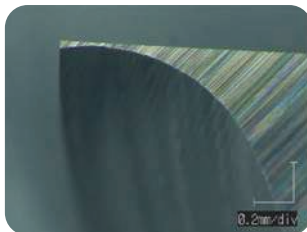


The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

### Diameter Tolerance

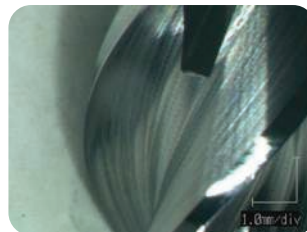
| Outside Diameter (φD)                         | Tolerance   |
|---|-------------|
| $\phi 1 \sim \phi 6, \phi 7, \phi 9, \phi 11$ | 0<br>-0.015 |
| $\phi 8, \phi 10, \phi 12$                    | 0<br>-0.005 |

#### Micro Flatland Design



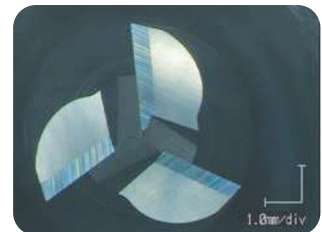
Excellent sharpness + Chipping protection design

#### Smooth Flute Design



Outstanding chip evacuation by seamless flute.

#### 3 Flute Design



Highly efficient 3 flutes. Significant productivity improvement.

Total 28 models

Unit (mm)

| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $B_{\alpha}$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|--------------------------------|------------------|-------------------------|--------------------------|
| AZS 3010-030 | 1                         | 3                         | 2                    | 0.95                     | 16°                            | 60               | 4                       | 5,880                    |
| AZS 3010-050 |                           | 5                         |                      |                          |                                | 60               |                         | 6,400                    |
| AZS 3015-045 | 1.5                       | 4.5                       | 3                    | 1.43                     | 16°                            | 60               | 4                       | 5,880                    |
| AZS 3020-060 | 2                         | 6                         | 4                    | 1.93                     | 16°                            | 60               | 4                       | 5,880                    |
| AZS 3020-100 |                           | 10                        |                      |                          |                                | 60               |                         | 6,400                    |
| AZS 3025-075 | 2.5                       | 7.5                       | 5                    | 2.4                      | 16°                            | 60               | 4                       | 7,080                    |
| AZS 3030-090 | 3                         | 9                         | 6                    | 2.9                      | 16°                            | 70               | 6                       | 7,080                    |
| AZS 3030-150 |                           | 15                        |                      |                          |                                | 70               |                         | 7,700                    |
| AZS 3035-105 | 3.5                       | 10.5                      | 7                    | 3.4                      | 16°                            | 70               | 6                       | 7,320                    |
| AZS 3040-120 | 4                         | 12                        | 8                    | 3.9                      | 16°                            | 70               | 6                       | 7,320                    |
| AZS 3040-200 |                           | 20                        |                      |                          |                                | 70               |                         | 8,000                    |
| AZS 3045-135 | 4.5                       | 13.5                      | 9                    | 4.4                      | 16°                            | 70               | 6                       | 7,920                    |
| AZS 3050-150 | 5                         | 15                        | 10                   | 4.9                      | 16°                            | 70               | 6                       | 7,920                    |
| AZS 3050-250 |                           | 25                        |                      |                          |                                | 70               |                         | 8,700                    |
| AZS 3060-180 | 6                         | 18                        | 12                   | 5.8                      | —                              | 70               | 6                       | 8,280                    |
| AZS 3060-300 |                           | 30                        |                      |                          |                                | 70               |                         | 9,100                    |
| AZS 3070-210 | 7                         | 21                        | 14                   | 6.82                     | 16°                            | 80               | 8                       | 11,040                   |
| AZS 3070-350 |                           | 35                        |                      |                          |                                | 80               |                         | 12,100                   |
| AZS 3080-240 | 8                         | 24                        | 16                   | 7.82                     | —                              | 80               | 8                       | 11,040                   |
| AZS 3080-400 |                           | 40                        |                      |                          |                                | 80               |                         | 12,100                   |
| AZS 3090-270 | 9                         | 27                        | 18                   | 8.82                     | 16°                            | 90               | 10                      | 13,920                   |
| AZS 3090-450 |                           | 45                        |                      |                          |                                | 90               |                         | 15,300                   |
| AZS 3100-300 | 10                        | 30                        | 20                   | 9.82                     | —                              | 90               | 10                      | 13,920                   |
| AZS 3100-500 |                           | 50                        |                      |                          |                                | 90               |                         | 15,300                   |
| AZS 3110-330 | 11                        | 33                        | 22                   | 10.82                    | 16°                            | 110              | 12                      | 19,560                   |
| AZS 3110-550 |                           | 55                        |                      |                          |                                | 110              |                         | 21,500                   |
| AZS 3120-360 | 12                        | 36                        | 24                   | 11.82                    | —                              | 110              | 12                      | 19,560                   |
| AZS 3120-600 |                           | 60                        |                      |                          |                                | 110              |                         | 21,500                   |

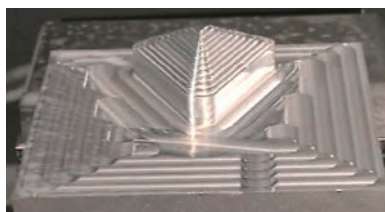
3 Flutes

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Square
  - Long Neck Square
- Radius
  - Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball
  - Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
  - Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

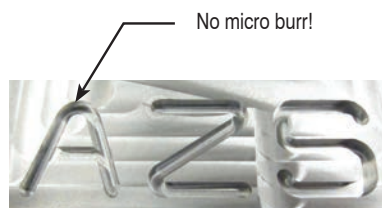
## Roughing Example

A5052

| Model Number                               | Milling Process     | Spindle Speed            | Z Feed Rate | XY Feed Rate | $a_p$ | $a_e$ | Cycle Time   |
|--|---------------------|--------------------------|-------------|--------------|-------|-------|--------------|
| AZS 3100-300<br>( $\phi 10 \times EL 30$ ) | Drilling ①          | 6,480 min <sup>-1</sup>  | 180 mm/min  | —            | 10 mm | —     | 6 min 35 sec |
|  | Roughing            |                          | —           | 1,500 mm/min | 10 mm | 5 mm  |              |
|  | Drilling ②          |                          | 180 mm/min  | —            | 20 mm | —     |              |
|  | Roughing            |                          | —           | 1,500 mm/min | 20 mm | 5 mm  |              |
| AZS 3030-090<br>( $\phi 3 \times EL 9$ )   | Drilling + Slotting | 14,000 min <sup>-1</sup> | 145 mm/min  | 1,450 mm/min | 3 mm  | —     | 30 sec       |



Coolant : Water Soluble



## Pocket Milling Example

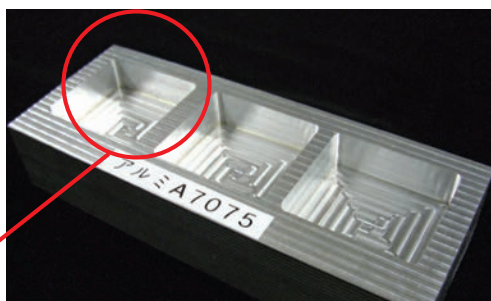
A7075

| Tool            | AZS 3060-180 ( $\phi 6 \times EL 18$ ) |                          |
|-----------------|--|--------------------------|
| Milling Process | Roughing                               | Finishing                |
| Spindle Speed   | 17,600 min <sup>-1</sup>               | 17,600 min <sup>-1</sup> |
| Feed Rate       | 3,000 mm/min                           | 2,000 mm/min             |
| $a_p$           | 6 mm                                   | 6 mm                     |
| $a_e$           | 4.8 mm                                 | 0.3 mm                   |

AZS series  
A7075  
Milling Video



Bottom



Milling from roughing to finishing  
with 1 pc.

Pocket size : 50 x 50 x 18 mm  
Coolant : Oil Mist








- Coolant Water soluble
- Overhang 20 mm



Tool used  
AZS  $\phi 5 \times L10 \times EL15$

### ◆ Feed per tooth fixed at 0.05 mm/t. Comparison of burrs at different spindle speeds and feed rates.



|             | Spindle speed (min <sup>-1</sup> ) | Feed rate (mm/min) | Velocity (m/min) | $a_p$ (mm)   | Feed per tooth (mm/t) | Milling condition details   | Slot wall Down cut side  |
|-------------|------------------------------------|--------------------|------------------|--------------|-----------------------|---|--|
| Condition 1 | 13,000                             | 2,000              | 200              | 3.75 (0.75D) | 0.05                  | Spindle speed and feed rate = Catalogue milling conditions                | <br>Best result |
| Condition 2 | 11,700                             | 1,750              | 180              |              |                       | Spindle speed and feed rate = 10% lower than catalogue milling conditions |                 |
| Condition 3 | 10,000                             | 1,500              | 160              |              |                       | Spindle speed and feed rate = 25% lower than catalogue milling conditions | <br>Some burrs  |
| Condition 4 | 7,700                              | 1,150              | 120              |              |                       | Spindle speed and feed rate = 40% lower than catalogue milling conditions |                 |
| Condition 5 | 3,200                              | 480                | 50               |              |                       | Spindle speed and feed rate = 75% lower than catalogue milling conditions | <br>Most burrs |

No burrs under condition 1, catalogue milling conditions.

As the spindle speed was lowered, burrs began to appear, and the most burrs occurred at the velocity of 50 m/min in condition 5.

At the same feed per tooth, burrs were more likely to occur if the velocity was reduced too much.

### ◆ Spindle speed fixed at 10,000min<sup>-1</sup>. Comparison of burrs at different feed rates.

|             | Spindle speed (min <sup>-1</sup> ) | Feed rate (mm/min) | Velocity (m/min) | $a_p$ (mm)   | Feed per tooth (mm/t) | Milling condition details                                    | Slot wall Down cut side   |
|-------------|------------------------------------|--------------------|------------------|--------------|-----------------------|--|---|
| Condition 6 | 10,000                             | 2,000              | 160              | 3.75 (0.75D) | 0.07                  | Spindle speed 10,000min <sup>-1</sup><br>Feed per tooth +30% |  |
| Condition 7 |                                    | 2,400              |                  |              | 0.08                  | Spindle speed 10,000min <sup>-1</sup><br>Feed per tooth +60% |  |

At a fixed spindle speed of 10,000 min<sup>-1</sup>, burrs slightly increased compared to condition 3 when the feed rate was raised, but there was no significant difference.

- $\phi 3$ mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Size  $\phi 1 \sim \phi 12$

# DLC-AZS



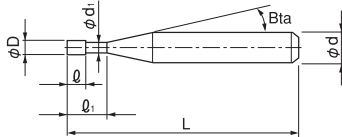
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        | ★         |                 |          | ○      | ○        |                       |                 |                       |                  |                                       |

## Features

- Capable of vertical milling directly into a plane surface.
- Achieves shorter processing time by removing pre-drilling or ramping cycle.
- DLC COAT offers excellent resistance to wear and welding.
- 45° helix angle offers excellent chip evacuation.
- The flute shape is specifically designed for reducing burrs on Aluminum Alloys.
- The micro flatland design greatly helps control of chipping.

The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



### Diameter Tolerance

| Outside Diameter (φD)                         | Tolerance   |
|---|-------------|
| $\phi 1 \sim \phi 6, \phi 7, \phi 9, \phi 11$ | 0<br>-0.015 |
| $\phi 8, \phi 10, \phi 12$                    | 0<br>-0.005 |

Total 28 models

Unit (mm)

| Model Number     | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta ta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|------------------|---------------------------|---------------------------|----------------------|--------------------------|------------------------------|------------------|-------------------------|--------------------------|
| DLC-AZS 3010-030 | 1                         | 3                         | 2                    | 0.95                     | 16°                          | 60               | 4                       | 6,200                    |
| DLC-AZS 3010-050 |                           | 5                         |                      |                          |                              | 60               |                         | 6,750                    |
| DLC-AZS 3015-045 | 1.5                       | 4.5                       | 3                    | 1.43                     | 16°                          | 60               | 4                       | 6,200                    |
| DLC-AZS 3020-060 | 2                         | 6                         | 4                    | 1.93                     | 16°                          | 60               | 4                       | 6,200                    |
| DLC-AZS 3020-100 |                           | 10                        |                      |                          |                              | 60               |                         | 6,750                    |
| DLC-AZS 3025-075 | 2.5                       | 7.5                       | 5                    | 2.4                      | 16°                          | 60               | 4                       | 7,400                    |
| DLC-AZS 3030-090 | 3                         | 9                         | 6                    | 2.9                      | 16°                          | 70               | 6                       | 7,400                    |
| DLC-AZS 3030-150 |                           | 15                        |                      |                          |                              | 70               |                         | 8,050                    |

Unit (mm)

| Model Number     | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|------------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| DLC-AZS 3035-105 | 3.5                       | 10.5                      | 7                    | 3.4                      | 16°                   | 70               | 6                       | 7,700                    |
| DLC-AZS 3040-120 | 4                         | 12                        | 8                    | 3.9                      | 16°                   | 70               | 6                       | 7,700                    |
| DLC-AZS 3040-200 |                           | 20                        |                      |                          |                       | 70               |                         | 6                        |
| DLC-AZS 3045-135 | 4.5                       | 13.5                      | 9                    | 4.4                      | 16°                   | 70               | 6                       | 8,300                    |
| DLC-AZS 3050-150 | 5                         | 15                        | 10                   | 4.9                      | 16°                   | 70               | 6                       | 8,300                    |
| DLC-AZS 3050-250 |                           | 25                        |                      |                          |                       | 70               |                         | 6                        |
| DLC-AZS 3060-180 | 6                         | 18                        | 12                   | 5.8                      | —                     | 70               | 6                       | 8,700                    |
| DLC-AZS 3060-300 |                           | 30                        |                      |                          |                       | 70               |                         | 6                        |
| DLC-AZS 3070-210 | 7                         | 21                        | 14                   | 6.82                     | 16°                   | 80               | 8                       | 11,600                   |
| DLC-AZS 3070-350 |                           | 35                        |                      |                          |                       | 80               |                         | 8                        |
| DLC-AZS 3080-240 | 8                         | 24                        | 16                   | 7.82                     | —                     | 80               | 8                       | 11,600                   |
| DLC-AZS 3080-400 |                           | 40                        |                      |                          |                       | 80               |                         | 8                        |
| DLC-AZS 3090-270 | 9                         | 27                        | 18                   | 8.82                     | 16°                   | 90               | 10                      | 14,600                   |
| DLC-AZS 3090-450 |                           | 45                        |                      |                          |                       | 90               |                         | 10                       |
| DLC-AZS 3100-300 | 10                        | 30                        | 20                   | 9.82                     | —                     | 90               | 10                      | 14,600                   |
| DLC-AZS 3100-500 |                           | 50                        |                      |                          |                       | 90               |                         | 10                       |
| DLC-AZS 3110-330 | 11                        | 33                        | 22                   | 10.82                    | 16°                   | 110              | 12                      | 20,500                   |
| DLC-AZS 3110-550 |                           | 55                        |                      |                          |                       | 110              |                         | 12                       |
| DLC-AZS 3120-360 | 12                        | 36                        | 24                   | 11.82                    | —                     | 110              | 12                      | 20,500                   |
| DLC-AZS 3120-600 |                           | 60                        |                      |                          |                       | 110              |                         | 12                       |

3 Flutes

3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Radius

Long Neck  
RadiusTaper Neck  
Radius

Ball

Ball / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral  
V CutterSpiral  
V Cutter

Drill

Drill

Technical Data

Technical Data

Milling Conditions for AZS / DLC-AZS

◆ High speed & highly efficient milling conditions

| WORK MATERIAL       |                       |                       | A5052                              |                       |                     |                       |                     |  |                     |                     |
|---------------------|-----------------------|-----------------------|------------------------------------|-----------------------|---------------------|-----------------------|---------------------|--|---------------------|---------------------|
| Model Number        | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Vertical              |                     | Slotting              |                     | Side Milling                               |                     |                     |
|                     |                       |                       |                                    | Feed Rate (mm/min)    | a <sub>p</sub> (mm) | Feed Rate (mm/min)    | a <sub>p</sub> (mm) | Feed Rate (mm/min)                         | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |
| 3010-030            | 1                     | 3                     | 30,000                             | 150                   | 0.75                | 900                   | 0.75                | 1,100                                      | 0.75                | 0.3                 |
| 3010-050            |                       | 5                     | 22,500                             | 100                   | 0.75                | 600                   | 0.75                | 800  | 0.75                | 0.3                 |
| 3015-045            | 1.5                   | 4.5                   | 30,000                             | 180                   | 1.125               | 1,350                 | 1.125               | 1,630                                      | 1.125               | 0.45                |
| 3020-060            | 2                     | 6                     | 30,000                             | 225                   | 1.5                 | 1,800                 | 1.5                 | 2,150                                      | 1.5                 | 0.6                 |
| 3020-100            |                       | 10                    | 22,500                             | 150                   | 1.5                 | 1,300                 | 1.5                 | 1,500                                      | 1.5                 | 0.6                 |
| 3025-075            | 2.5                   | 7.5                   | 25,000                             | 225                   | 1.875               | 1,900                 | 1.875               | 2,300                                      | 1.875               | 0.75                |
| 3030-090            | 3                     | 9                     | 21,600                             | 225                   | 2.25                | 2,000                 | 2.25                | 2,400                                      | 2.25                | 0.9                 |
| 3030-150            |                       | 15                    | 16,200                             | 150                   | 2.25                | 1,400                 | 2.25                | 1,700                                      | 2.25                | 0.9                 |
| 3035-105            | 3.5                   | 10.5                  | 18,500                             | 270                   | 2.625               | 2,000                 | 2.625               | 2,400                                      | 2.625               | 1.05                |
| 3040-120            | 4                     | 12                    | 16,200                             | 300                   | 3                   | 2,000                 | 3                   | 2,400                                      | 3                   | 1.2                 |
| 3040-200            |                       | 20                    | 12,200                             | 200                   | 3                   | 1,400                 | 3                   | 1,700                                      | 3                   | 1.2                 |
| 3045-135            | 4.5                   | 13.5                  | 14,400                             | 300                   | 3.375               | 2,000                 | 3.375               | 2,400                                      | 3.375               | 1.35                |
| 3050-150            | 5                     | 15                    | 12,960                             | 300                   | 3.75                | 2,000                 | 3.75                | 2,400                                      | 3.75                | 1.5                 |
| 3050-250            |                       | 25                    | 9,700                              | 200                   | 3.75                | 1,400                 | 3.75                | 1,700                                      | 3.75                | 1.5                 |
| 3060-180            | 6                     | 18                    | 10,800                             | 300                   | 4.5                 | 2,000                 | 4.5                 | 2,400                                      | 4.5                 | 1.8                 |
| 3060-300            |                       | 30                    | 8,100                              | 200                   | 4.5                 | 1,400                 | 4.5                 | 1,700                                      | 4.5                 | 1.8                 |
| 3070-210            | 7                     | 21                    | 9,300                              | 300                   | 5.25                | 2,000                 | 5.25                | 2,400                                      | 5.25                | 2.1                 |
| 3070-350            |                       | 35                    | 6,900                              | 200                   | 5.25                | 1,400                 | 5.25                | 1,700                                      | 5.25                | 2.1                 |
| 3080-240            | 8                     | 24                    | 11,400                             | 300                   | 6                   | 2,200                 | 6                   | 2,600                                      | 6                   | 2.4                 |
| 3080-400            |                       | 40                    | 8,600                              | 200                   | 6                   | 1,500                 | 6                   | 1,800                                      | 6                   | 2.4                 |
| 3090-270            | 9                     | 27                    | 7,200                              | 275                   | 6.75                | 2,000                 | 6.75                | 2,400                                      | 6.75                | 2.7                 |
| 3090-450            |                       | 45                    | 5,400                              | 180                   | 6.75                | 1,400                 | 6.75                | 1,700                                      | 6.75                | 2.7                 |
| 3100-300            | 10                    | 30                    | 9,100                              | 250                   | 7.5                 | 2,200                 | 7.5                 | 2,600                                      | 7.5                 | 3                   |
| 3100-500            |                       | 50                    | 6,800                              | 160                   | 7.5                 | 1,500                 | 7.5                 | 1,800                                      | 7.5                 | 3                   |
| 3110-330            | 11                    | 33                    | 5,900                              | 225                   | 8.25                | 2,000                 | 8.25                | 2,400                                      | 8.25                | 3.3                 |
| 3110-550            |                       | 55                    | 4,400                              | 145                   | 8.25                | 1,400                 | 8.25                | 1,700                                      | 8.25                | 3.3                 |
| 3120-360            | 12                    | 36                    | 7,600                              | 200                   | 9                   | 2,200                 | 9                   | 2,600                                      | 9                   | 3.6                 |
| 3120-600            |                       | 60                    | 5,700                              | 130                   | 9                   | 1,500                 | 9                   | 1,800                                      | 9                   | 3.6                 |
| Milling Amount (mm) |                       |                       |                                    | a <sub>p</sub> =0.75D |                     | a <sub>p</sub> =0.75D |                     | a <sub>p</sub> =0.75D a <sub>e</sub> =0.3D |                     |                     |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



# Milling Conditions for AZS / DLC-AZS

3 Flutes

| WORK MATERIAL       |                       |                       | A7075                              |                       |                     |                       |                     |  |                     |                     |
|---------------------|-----------------------|-----------------------|------------------------------------|-----------------------|---------------------|-----------------------|---------------------|--|---------------------|---------------------|
| Model Number        | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Vertical              |                     | Slotting              |                     | Side Milling                               |                     |                     |
|                     |                       |                       |                                    | Feed Rate (mm/min)    | a <sub>p</sub> (mm) | Feed Rate (mm/min)    | a <sub>p</sub> (mm) | Feed Rate (mm/min)                         | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |
| 3010-030            | 1                     | 3                     | 30,000                             | 150                   | 0.75                | 540                   | 0.75                | 860  | 0.75                | 0.3                 |
| 3010-050            |                       | 5                     | 22,500                             | 100                   | 0.75                | 400                   | 0.75                | 600  | 0.75                | 0.3                 |
| 3015-045            | 1.5                   | 4.5                   | 30,000                             | 180                   | 1.125               | 820                   | 1.125               | 1,230                                      | 1.125               | 0.45                |
| 3020-060            | 2                     | 6                     | 30,000                             | 225                   | 1.5                 | 1,100                 | 1.5                 | 1,600                                      | 1.5                 | 0.6                 |
| 3020-100            |                       | 10                    | 22,500                             | 150                   | 1.5                 | 800                   | 1.5                 | 1,100                                      | 1.5                 | 0.6                 |
| 3025-075            | 2.5                   | 7.5                   | 23,400                             | 220                   | 1.875               | 1,070                 | 1.875               | 1,550                                      | 1.875               | 0.75                |
| 3030-090            | 3                     | 9                     | 20,200                             | 225                   | 2.25                | 1,100                 | 2.25                | 1,600                                      | 2.25                | 0.9                 |
| 3030-150            |                       | 15                    | 15,200                             | 150                   | 2.25                | 800                   | 2.25                | 1,100                                      | 2.25                | 0.9                 |
| 3035-105            | 3.5                   | 10.5                  | 17,300                             | 270                   | 2.625               | 1,100                 | 2.625               | 1,600                                      | 2.625               | 1.05                |
| 3040-120            | 4                     | 12                    | 15,200                             | 300                   | 3                   | 1,100                 | 3                   | 1,600                                      | 3                   | 1.2                 |
| 3040-200            |                       | 20                    | 11,400                             | 200                   | 3                   | 800                   | 3                   | 1,100                                      | 3                   | 1.2                 |
| 3045-135            | 4.5                   | 13.5                  | 13,500                             | 300                   | 3.375               | 1,100                 | 3.375               | 1,600                                      | 3.375               | 1.35                |
| 3050-150            | 5                     | 15                    | 12,200                             | 300                   | 3.75                | 1,100                 | 3.75                | 1,600                                      | 3.75                | 1.5                 |
| 3050-250            |                       | 25                    | 9,200                              | 200                   | 3.75                | 800                   | 3.75                | 1,100                                      | 3.75                | 1.5                 |
| 3060-180            | 6                     | 18                    | 10,100                             | 300                   | 4.5                 | 1,100                 | 4.5                 | 1,600                                      | 4.5                 | 1.8                 |
| 3060-300            |                       | 30                    | 7,600                              | 200                   | 4.5                 | 800                   | 4.5                 | 1,100                                      | 4.5                 | 1.8                 |
| 3070-210            | 7                     | 21                    | 8,700                              | 250                   | 5.25                | 1,100                 | 5.25                | 1,600                                      | 5.25                | 2.1                 |
| 3070-350            |                       | 35                    | 6,500                              | 160                   | 5.25                | 800                   | 5.25                | 1,100                                      | 5.25                | 2.1                 |
| 3080-240            | 8                     | 24                    | 12,000                             | 250                   | 6                   | 1,800                 | 6                   | 2,400                                      | 6                   | 2.4                 |
| 3080-400            |                       | 40                    | 9,000                              | 160                   | 6                   | 1,300                 | 6                   | 1,700                                      | 6                   | 2.4                 |
| 3090-270            | 9                     | 27                    | 6,700                              | 250                   | 6.75                | 1,100                 | 6.75                | 1,600                                      | 6.75                | 2.7                 |
| 3090-450            |                       | 45                    | 5,100                              | 160                   | 6.75                | 800                   | 6.75                | 1,100                                      | 6.75                | 2.7                 |
| 3100-300            | 10                    | 30                    | 9,600                              | 250                   | 7.5                 | 1,800                 | 7.5                 | 2,400                                      | 7.5                 | 3                   |
| 3100-500            |                       | 50                    | 7,200                              | 160                   | 7.5                 | 1,300                 | 7.5                 | 1,700                                      | 7.5                 | 3                   |
| 3110-330            | 11                    | 33                    | 5,500                              | 250                   | 8.25                | 1,100                 | 8.25                | 1,600                                      | 8.25                | 3.3                 |
| 3110-550            |                       | 55                    | 4,100                              | 160                   | 8.25                | 800                   | 8.25                | 1,100                                      | 8.25                | 3.3                 |
| 3120-360            | 12                    | 36                    | 8,000                              | 250                   | 9                   | 1,800                 | 9                   | 2,400                                      | 9                   | 3.6                 |
| 3120-600            |                       | 60                    | 6,000                              | 160                   | 9                   | 1,300                 | 9                   | 1,700                                      | 9                   | 3.6                 |
| Milling Amount (mm) |                       |                       |                                    | a <sub>p</sub> =0.75D |                     | a <sub>p</sub> =0.75D |                     | a <sub>p</sub> =0.75D a <sub>e</sub> =0.3D |                     |                     |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Long Neck Square
- Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball
  - Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
  - Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for AZS / DLC-AZS

◆ Low speed & highly efficient milling conditions (Assumed maximum spindle speed: 10,000 min<sup>-1</sup> or below)

| WORK MATERIAL       |                       |                       | A5052                              |                      |                     |                      |                     |  |                     |                     |
|---------------------|-----------------------|-----------------------|------------------------------------|----------------------|---------------------|----------------------|---------------------|--|---------------------|---------------------|
| Model Number        | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Vertical             |                     | Slotting             |                     | Side Milling                               |                     |                     |
|                     |                       |                       |                                    | Feed Rate (mm/min)   | a <sub>p</sub> (mm) | Feed Rate (mm/min)   | a <sub>p</sub> (mm) | Feed Rate (mm/min)                         | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) |
| 3010-030            | 1                     | 3                     | 10,000                             | 50                   | 0.3                 | 400                  | 0.3                 | 900  | 1                   | 0.15                |
| 3015-045            | 1.5                   | 4.5                   | 10,000                             | 80                   | 0.45                | 600                  | 0.45                | 1,250                                      | 1.5                 | 0.225               |
| 3020-060            | 2                     | 6                     | 10,000                             | 100                  | 0.6                 | 800                  | 0.6                 | 1,600                                      | 2                   | 0.3                 |
| 3025-075            | 2.5                   | 7.5                   | 10,000                             | 130                  | 0.75                | 1,000                | 0.75                | 2,050                                      | 2.5                 | 0.375               |
| 3030-090            | 3                     | 9                     | 10,000                             | 150                  | 0.9                 | 1,200                | 0.9                 | 2,500                                      | 3                   | 0.45                |
| 3035-105            | 3.5                   | 10.5                  | 10,000                             | 180                  | 1.05                | 1,400                | 1.05                | 2,600                                      | 3.5                 | 0.525               |
| 3040-120            | 4                     | 12                    | 10,000                             | 200                  | 1.2                 | 1,600                | 1.2                 | 2,700                                      | 4                   | 0.6                 |
| 3045-135            | 4.5                   | 13.5                  | 10,000                             | 230                  | 1.35                | 1,800                | 1.35                | 3,050                                      | 4.5                 | 0.675               |
| 3050-150            | 5                     | 15                    | 10,000                             | 250                  | 1.5                 | 2,000                | 1.5                 | 3,400                                      | 5                   | 0.75                |
| 3060-180            | 6                     | 18                    | 10,000                             | 300                  | 1.8                 | 2,400                | 1.8                 | 4,000                                      | 6                   | 0.9                 |
| 3070-210            | 7                     | 21                    | 8,600                              | 300                  | 2.1                 | 2,400                | 2.1                 | 4,000                                      | 7                   | 1.05                |
| 3080-240            | 8                     | 24                    | 8,100                              | 300                  | 2.4                 | 3,000                | 2.4                 | 4,800                                      | 8                   | 1.2                 |
| 3090-270            | 9                     | 27                    | 6,700                              | 275                  | 2.7                 | 2,400                | 2.7                 | 4,000                                      | 9                   | 1.35                |
| 3100-300            | 10                    | 30                    | 6,480                              | 250                  | 3                   | 3,000                | 3                   | 4,800                                      | 10                  | 1.5                 |
| 3110-330            | 11                    | 33                    | 5,500                              | 225                  | 3.3                 | 2,400                | 3.3                 | 4,000                                      | 11                  | 1.65                |
| 3120-360            | 12                    | 36                    | 5,400                              | 200                  | 3.6                 | 3,000                | 3.6                 | 4,800                                      | 12                  | 1.8                 |
| Milling Amount (mm) |                       |                       |                                    | a <sub>p</sub> =0.3D |                     | a <sub>p</sub> =0.3D |                     | a <sub>p</sub> =1.0D a <sub>e</sub> =0.15D |                     |                     |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

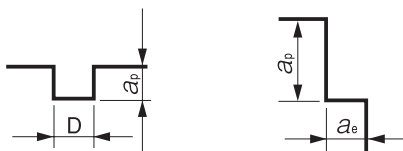
Technical Data

# Milling Conditions for AZS / DLC-AZS

3 Flutes

| WORK MATERIAL       |                       |                       | A7075                              |                    |            |                    |            |                        |            |            |
|---------------------|-----------------------|-----------------------|------------------------------------|--------------------|------------|--------------------|------------|------------------------|------------|------------|
| Model Number        | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Vertical           |            | Slotting           |            | Side Milling           |            |            |
|                     |                       |                       |                                    | Feed Rate (mm/min) | $a_p$ (mm) | Feed Rate (mm/min) | $a_p$ (mm) | Feed Rate (mm/min)     | $a_p$ (mm) | $a_e$ (mm) |
| 3010-030            | 1                     | 3                     | 10,000                             | 50                 | 0.3        | 400                | 0.3        | 750                    | 1          | 0.15       |
| 3015-045            | 1.5                   | 4.5                   | 10,000                             | 80                 | 0.45       | 600                | 0.45       | 1,130                  | 1.5        | 0.225      |
| 3020-060            | 2                     | 6                     | 10,000                             | 100                | 0.6        | 800                | 0.6        | 1,500                  | 2          | 0.3        |
| 3025-075            | 2.5                   | 7.5                   | 10,000                             | 130                | 0.75       | 1,000              | 0.75       | 1,880                  | 2.5        | 0.375      |
| 3030-090            | 3                     | 9                     | 10,000                             | 150                | 0.9        | 1,200              | 0.9        | 2,250                  | 3          | 0.45       |
| 3035-105            | 3.5                   | 10.5                  | 10,000                             | 180                | 1.05       | 1,400              | 1.05       | 2,380                  | 3.5        | 0.525      |
| 3040-120            | 4                     | 12                    | 10,000                             | 200                | 1.2        | 1,600              | 1.2        | 2,500                  | 4          | 0.6        |
| 3045-135            | 4.5                   | 13.5                  | 10,000                             | 230                | 1.35       | 1,800              | 1.35       | 2,750                  | 4.5        | 0.675      |
| 3050-150            | 5                     | 15                    | 9,600                              | 250                | 1.5        | 2,000              | 1.5        | 3,000                  | 5          | 0.75       |
| 3060-180            | 6                     | 18                    | 8,000                              | 250                | 1.8        | 2,000              | 1.8        | 3,000                  | 6          | 0.9        |
| 3070-210            | 7                     | 21                    | 6,900                              | 200                | 2.1        | 2,000              | 2.1        | 3,000                  | 7          | 1.05       |
| 3080-240            | 8                     | 24                    | 10,000                             | 200                | 2.4        | 2,400              | 2.4        | 4,100                  | 8          | 1.2        |
| 3090-270            | 9                     | 27                    | 5,300                              | 200                | 2.7        | 2,000              | 2.7        | 3,000                  | 9          | 1.35       |
| 3100-300            | 10                    | 30                    | 8,100                              | 200                | 3          | 2,400              | 3          | 4,200                  | 10         | 1.5        |
| 3110-330            | 11                    | 33                    | 4,400                              | 200                | 3.3        | 2,000              | 3.3        | 3,000                  | 11         | 1.65       |
| 3120-360            | 12                    | 36                    | 6,800                              | 200                | 3.6        | 2,400              | 3.6        | 4,200                  | 12         | 1.8        |
| Milling Amount (mm) |                       |                       |                                    | $a_p=0.3D$         |            | $a_p=0.3D$         |            | $a_p=1.0D$ $a_e=0.15D$ |            |            |

- Note:
- Recommend using a non-contact measuring device to avoid damaging the sharp bottom corner.
  - Decrease both spindle speed and feed rate proportionally in case of chattering.
  - These milling parameters are calculated based on the shortest overhang length. Longer overhangs may require an adjustment to the milling parameters.
  - Reduce the milling amount and feed rate in accordance with required milling precision.
  - Spindle rigidity should be considered when setting milling parameters, especially for Z-Axis drilling.
  - When slotting, using Z-Axis drilling, the milling parameters should promote good chip evacuation.
  - Reduce the milling amount when chips clog on the tool during Z-Axis drilling.
  - Set axial depth ( $a_p$ ) to 1/3 ( $a_p=0.25D$ ) in the area closest to a vertical wall with more than 2D work depth.
  - These are milling parameters under the work material is firmly fixed. Decrease spindle speed and feed rate according to the condition.
  - Recommend water soluble coolant.



D : Outside Diameter (mm)

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Long Neck Square
- Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
  - Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Size  $\phi 1 \sim \phi 6$

# HLS4000



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

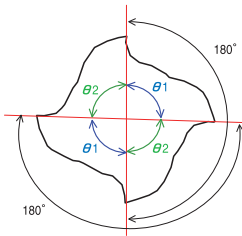
| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●      | ○      |        | ○      |           |                 |          | ○      |          |                       | ○               | ○                     |                  |                                       |

## Features

Feature1 : Variable pitch

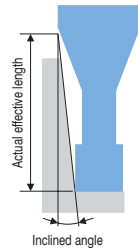
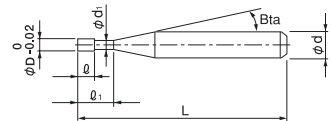
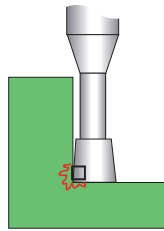
$\theta_1 > \theta_2$  : The unequal division reduces chattering and tip damage.

$\theta_1 + \theta_2 = 180^\circ$  : Easy to measure diameter.



Feature2 : Back taper geometry

Back taper geometry reduces cutting force.



Feature3 : HARDMAX coating with high level of heat resistance, durability and lubrication.

Feature4 : Improved new 4 flute design offers improved chip evacuation and achieves high feed and milling precision.

The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Refer to page 242 for 2 flute HLS.

Total 84 models

Unit (mm)

| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |        |       |       |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|--------|-------|-------|
|              |                           |                           |                      |                          |                       |                  |                         |                          | 30'                                 | 1°    | 1° 30' | 2°    | 3°    |
| HLS 4010-040 | 1                         | 4                         | 1                    | 0.95                     | 16°                   | 50               | 4                       | 4,800                    | 4.66                                | 4.93  | 5.15   | 5.34  | 5.74  |
| HLS 4010-060 |                           | 6                         |                      |                          |                       | 50               | 4                       | 4,800                    | 6.78                                | 7.10  | 7.36   | 7.62  | 8.19  |
| HLS 4010-080 |                           | 8                         |                      |                          |                       | 50               | 4                       | 4,800                    | 8.88                                | 9.25  | 9.56   | 9.90  | 10.64 |
| HLS 4010-100 |                           | 10                        |                      |                          |                       | 50               | 4                       | 4,800                    | 10.97                               | 11.38 | 11.76  | 12.17 | 13.09 |
| HLS 4010-120 |                           | 12                        |                      |                          |                       | 50               | 4                       | 4,800                    | 13.06                               | 13.51 | 13.97  | 14.45 | 15.53 |
| HLS 4010-160 |                           | 16                        |                      |                          |                       | 60               | 4                       | 7,680                    | 17.20                               | 17.77 | 18.37  | 19.01 | 20.43 |
| HLS 4012-060 | 1.2                       | 6                         | 1.2                  | 1.14                     | 16°                   | 50               | 4                       | 4,800                    | 6.18                                | 6.38  | 6.60   | 6.83  | 7.34  |
| HLS 4012-080 |                           | 8                         |                      |                          |                       | 50               | 4                       | 4,800                    | 8.24                                | 8.51  | 8.80   | 9.11  | 9.79  |
| HLS 4012-100 |                           | 10                        |                      |                          |                       | 50               | 4                       | 4,800                    | 10.31                               | 10.64 | 11.00  | 11.38 | 12.24 |
| HLS 4012-120 |                           | 12                        |                      |                          |                       | 50               | 4                       | 4,800                    | 12.37                               | 12.77 | 13.20  | 13.66 | 14.68 |
| HLS 4012-160 |                           | 16                        |                      |                          |                       | 50               | 4                       | 6,720                    | 16.49                               | 17.03 | 17.60  | 18.22 | 19.58 |
|              |                           |                           |                      |                          |                       | 60               | 4                       | 6,720                    | 16.49                               | 17.03 | 17.60  | 18.22 | 19.58 |

Unit (mm)

| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |        |                 |                 |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|--------|-----------------|-----------------|
|              |                           |                           |                      |                          |                           |                  |                         |                          | 30°                                 | 1°    | 1° 30' | 2°              | 3°              |
| HLS 4014-060 | 1.4                       | 6                         | 1.4                  | 1.34                     | 16°                       | 50               | 4                       | 4,800                    | 6.18                                | 6.38  | 6.60   | 6.83            | 7.34            |
| HLS 4014-080 |                           | 8                         |                      |                          |                           | 50               | 4                       | 4,800                    | 8.24                                | 8.51  | 8.80   | 9.11            | 9.79            |
| HLS 4014-100 |                           | 10                        |                      |                          |                           | 50               | 4                       | 4,800                    | 10.31                               | 10.64 | 11.00  | 11.38           | 12.24           |
| HLS 4014-120 |                           | 12                        |                      |                          |                           | 50               | 4                       | 4,800                    | 12.37                               | 12.77 | 13.20  | 13.66           | 14.68           |
| HLS 4014-140 |                           | 14                        |                      |                          |                           | 60               | 4                       | 4,800                    | 14.43                               | 14.90 | 15.40  | 15.94           | 17.13           |
| HLS 4014-160 |                           | 16                        |                      |                          |                           | 60               | 4                       | 6,720                    | 16.49                               | 17.03 | 17.60  | 18.22           | 19.58           |
| HLS 4014-220 |                           | 22                        |                      |                          |                           | 60               | 4                       | 8,640                    | 22.68                               | 23.42 | 24.21  | 25.05           | No Interference |
| HLS 4015-060 |                           | 1.5                       |                      |                          |                           | 6                | 1.5                     | 1.44                     | 16°                                 | 50    | 4      | 4,800           | 6.18            |
| HLS 4015-080 | 8                         |                           | 50                   | 4                        | 4,800                     | 8.24             |                         |                          |                                     | 8.51  | 8.80   | 9.11            | 9.79            |
| HLS 4015-100 | 10                        |                           | 50                   | 4                        | 4,800                     | 10.31            |                         |                          |                                     | 10.64 | 11.00  | 11.38           | 12.24           |
| HLS 4015-120 | 12                        |                           | 50                   | 4                        | 4,800                     | 12.37            |                         |                          |                                     | 12.77 | 13.20  | 13.66           | 14.68           |
| HLS 4015-140 | 14                        |                           | 60                   | 4                        | 4,800                     | 14.43            |                         |                          |                                     | 14.90 | 15.40  | 15.94           | 17.13           |
| HLS 4015-160 | 16                        |                           | 60                   | 4                        | 4,800                     | 16.49            |                         |                          |                                     | 17.03 | 17.60  | 18.22           | 19.58           |
| HLS 4015-180 | 18                        |                           | 60                   | 4                        | 4,800                     | 18.56            |                         |                          |                                     | 19.16 | 19.80  | 20.49           | 22.03           |
| HLS 4015-200 | 20                        |                           | 60                   | 4                        | 4,800                     | 20.62            |                         |                          |                                     | 21.29 | 22.00  | 22.77           | No Interference |
| HLS 4016-060 | 1.6                       | 6                         | 1.6                  | 1.51                     | 16°                       | 50               | 4                       | 4,800                    | 6.22                                | 6.42  | 6.64   | 6.87            | 7.39            |
| HLS 4016-080 |                           | 8                         |                      |                          |                           | 50               | 4                       | 4,800                    | 8.28                                | 8.55  | 8.84   | 9.15            | 9.83            |
| HLS 4016-100 |                           | 10                        |                      |                          |                           | 50               | 4                       | 4,800                    | 10.34                               | 10.68 | 11.04  | 11.42           | 12.28           |
| HLS 4016-120 |                           | 12                        |                      |                          |                           | 50               | 4                       | 4,800                    | 12.40                               | 12.81 | 13.24  | 13.70           | 14.73           |
| HLS 4016-140 |                           | 14                        |                      |                          |                           | 60               | 4                       | 4,800                    | 14.47                               | 14.94 | 15.44  | 15.98           | 17.17           |
| HLS 4016-160 |                           | 16                        |                      |                          |                           | 60               | 4                       | 4,800                    | 16.53                               | 17.07 | 17.64  | 18.26           | 19.62           |
| HLS 4016-180 |                           | 18                        |                      |                          |                           | 60               | 4                       | 4,800                    | 18.59                               | 19.20 | 19.84  | 20.53           | 22.07           |
| HLS 4016-200 |                           | 20                        |                      |                          |                           | 60               | 4                       | 4,800                    | 20.66                               | 21.33 | 22.04  | 22.81           | No Interference |
| HLS 4016-260 |                           | 26                        |                      |                          |                           | 60               | 4                       | 11,040                   | 26.84                               | 27.72 | 28.65  | 29.64           | No Interference |
| HLS 4018-060 |                           | 1.8                       |                      |                          |                           | 6                | 1.8                     | 1.71                     | 16°                                 | 50    | 4      | 4,800           | 6.22            |
| HLS 4018-080 | 8                         |                           | 50                   | 4                        | 4,800                     | 8.28             |                         |                          |                                     | 8.55  | 8.84   | 9.15            | 9.83            |
| HLS 4018-100 | 10                        |                           | 50                   | 4                        | 4,800                     | 10.34            |                         |                          |                                     | 10.68 | 11.04  | 11.42           | 12.28           |
| HLS 4018-120 | 12                        |                           | 50                   | 4                        | 4,800                     | 12.40            |                         |                          |                                     | 12.81 | 13.24  | 13.70           | 14.73           |
| HLS 4018-140 | 14                        |                           | 60                   | 4                        | 4,800                     | 14.47            |                         |                          |                                     | 14.94 | 15.44  | 15.98           | 17.17           |
| HLS 4018-160 | 16                        |                           | 60                   | 4                        | 4,800                     | 16.53            |                         |                          |                                     | 17.07 | 17.64  | 18.26           | 19.62           |
| HLS 4018-180 | 18                        |                           | 60                   | 4                        | 4,800                     | 18.59            |                         |                          |                                     | 19.20 | 19.84  | 20.53           | No Interference |
| HLS 4018-200 | 20                        |                           | 60                   | 4                        | 4,800                     | 20.66            |                         |                          |                                     | 21.33 | 22.04  | 22.81           | No Interference |
| HLS 4018-250 | 25                        |                           | 70                   | 4                        | 6,720                     | 25.81            |                         |                          |                                     | 26.65 | 27.55  | 28.50           | No Interference |
| HLS 4020-060 | 2                         |                           | 6                    | 2                        | 1.91                      | 16°              |                         |                          |                                     | 50    | 4      | 4,800           | 6.22            |
| HLS 4020-080 |                           | 8                         | 50                   |                          |                           |                  | 4                       | 4,800                    | 8.28                                | 8.55  | 8.84   | 9.15            | 9.83            |
| HLS 4020-100 |                           | 10                        | 50                   |                          |                           |                  | 4                       | 4,800                    | 10.34                               | 10.68 | 11.04  | 11.42           | 12.28           |
| HLS 4020-120 |                           | 12                        | 50                   |                          |                           |                  | 4                       | 4,800                    | 12.40                               | 12.81 | 13.24  | 13.70           | 14.73           |
| HLS 4020-140 |                           | 14                        | 60                   |                          |                           |                  | 4                       | 4,800                    | 14.47                               | 14.94 | 15.44  | 15.98           | 17.17           |
| HLS 4020-160 |                           | 16                        | 60                   |                          |                           |                  | 4                       | 4,800                    | 16.53                               | 17.07 | 17.64  | 18.26           | No Interference |
| HLS 4020-180 |                           | 18                        | 60                   |                          |                           |                  | 4                       | 4,800                    | 18.59                               | 19.20 | 19.84  | 20.53           | No Interference |
| HLS 4020-200 |                           | 20                        | 60                   |                          |                           |                  | 4                       | 4,800                    | 20.66                               | 21.33 | 22.04  | 22.81           | No Interference |
| HLS 4020-250 |                           | 25                        | 70                   |                          |                           |                  | 4                       | 5,280                    | 25.81                               | 26.65 | 27.55  | 28.50           | No Interference |
| HLS 4020-300 |                           | 30                        | 70                   |                          |                           |                  | 4                       | 6,720                    | 30.97                               | 31.97 | 33.05  | No Interference | No Interference |

4 Flutes

33mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius

Long Neck  
RadiusTaper Neck  
Radius

Ball

Ball / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

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289

Unit (mm)

| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|              |                           |                           |                      |                          |                       |                  |                         |                          | 30'                                 | 1°              | 1° 30'          | 2°              | 3°              |
| HLS 4025-080 | 2.5                       | 8                         | 2.5                  | 2.41                     | 16°                   | 50               | 4                       | 4,800                    | 8.28                                | 8.55            | 8.84            | 9.15            | 9.83            |
| HLS 4025-120 |                           | 12                        |                      |                          |                       | 50               | 4                       | 4,800                    | 12.40                               | 12.81           | 13.24           | 13.70           | No Interference |
| HLS 4025-160 |                           | 16                        |                      |                          |                       | 60               | 4                       | 4,800                    | 16.53                               | 17.07           | 17.64           | 18.26           | No Interference |
| HLS 4025-200 |                           | 20                        |                      |                          |                       | 60               | 4                       | 4,800                    | 20.66                               | 21.33           | 22.04           | No Interference | No Interference |
| HLS 4025-250 |                           | 25                        |                      |                          |                       | 70               | 4                       | 4,800                    | 25.81                               | 26.65           | 27.55           | No Interference | No Interference |
| HLS 4025-300 |                           | 30                        |                      |                          |                       | 70               | 4                       | 5,280                    | 30.97                               | 31.97           | No Interference | No Interference | No Interference |
| HLS 4030-080 | 3                         | 8                         | 3                    | 2.92                     | 16°                   | 50               | 6                       | 6,720                    | 8.28                                | 8.55            | 8.84            | 9.15            | 9.83            |
| HLS 4030-120 |                           | 12                        |                      |                          |                       | 50               | 6                       | 6,720                    | 12.40                               | 12.81           | 13.24           | 13.70           | 14.73           |
| HLS 4030-160 |                           | 16                        |                      |                          |                       | 60               | 6                       | 6,720                    | 16.53                               | 17.07           | 17.64           | 18.26           | 19.62           |
| HLS 4030-200 |                           | 20                        |                      |                          |                       | 60               | 6                       | 6,720                    | 20.66                               | 21.33           | 22.04           | 22.81           | 24.52           |
| HLS 4030-250 |                           | 25                        |                      |                          |                       | 70               | 6                       | 6,720                    | 25.81                               | 26.65           | 27.55           | 28.50           | No Interference |
| HLS 4030-300 |                           | 30                        |                      |                          |                       | 70               | 6                       | 8,640                    | 30.97                               | 31.97           | 33.05           | 34.20           | No Interference |
| HLS 4030-400 | 40                        | 80                        | 6                    | 8,640                    | 41.28                 | 42.62            | 44.05                   | No Interference          | No Interference                     |                 |                 |                 |                 |
| HLS 4040-120 | 4                         | 12                        | 4                    | 3.82                     | 16°                   | 50               | 6                       | 7,560                    | 12.58                               | 12.99           | 13.43           | 13.90           | 14.94           |
| HLS 4040-160 |                           | 16                        |                      |                          |                       | 60               | 6                       | 7,560                    | 16.71                               | 17.25           | 17.83           | 18.45           | No Interference |
| HLS 4040-200 |                           | 20                        |                      |                          |                       | 60               | 6                       | 7,560                    | 20.84                               | 21.51           | 22.24           | 23.01           | No Interference |
| HLS 4040-250 |                           | 25                        |                      |                          |                       | 70               | 6                       | 7,560                    | 25.99                               | 26.84           | 27.74           | 28.70           | No Interference |
| HLS 4040-300 |                           | 30                        |                      |                          |                       | 70               | 6                       | 7,560                    | 31.15                               | 32.16           | 33.24           | No Interference | No Interference |
| HLS 4040-350 |                           | 35                        |                      |                          |                       | 80               | 6                       | 7,560                    | 36.31                               | 37.48           | No Interference | No Interference | No Interference |
| HLS 4040-400 | 40                        | 90                        | 6                    | 9,600                    | 41.46                 | 42.81            | No Interference         | No Interference          | No Interference                     |                 |                 |                 |                 |
| HLS 4040-450 | 45                        | 90                        | 6                    | 11,520                   | 46.62                 | 48.13            | No Interference         | No Interference          | No Interference                     |                 |                 |                 |                 |
| HLS 4040-500 | 50                        | 100                       | 6                    | 14,520                   | 51.78                 | 53.46            | No Interference         | No Interference          | No Interference                     |                 |                 |                 |                 |
| HLS 4050-160 | 5                         | 16                        | 5                    | 4.82                     | 16°                   | 60               | 6                       | 9,600                    | 16.78                               | 17.25           | 18.02           | No Interference | No Interference |
| HLS 4050-250 |                           | 25                        |                      |                          |                       | 70               | 6                       | 9,600                    | 25.99                               | 26.84           | No Interference | No Interference | No Interference |
| HLS 4050-350 |                           | 35                        |                      |                          |                       | 80               | 6                       | 9,600                    | 36.31                               | No Interference | No Interference | No Interference | No Interference |
| HLS 4050-500 |                           | 50                        |                      |                          |                       | 110              | 6                       | 14,520                   | 51.78                               | No Interference | No Interference | No Interference | No Interference |
| HLS 4060-200 | 6                         | 20                        | 6                    | 5.82                     | —                     | 80               | 6                       | 9,600                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLS 4060-300 |                           | 30                        |                      |                          |                       | 90               | 6                       | 9,600                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLS 4060-400 |                           | 40                        |                      |                          |                       | 100              | 6                       | 11,520                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLS 4060-500 |                           | 50                        |                      |                          |                       | 110              | 6                       | 14,520                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |

Circle Pocket Milling Example

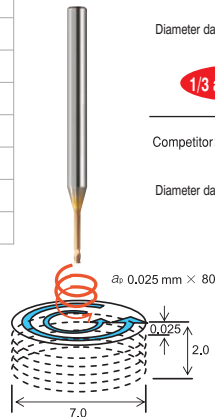
SKD11 (60HRC)

Tool: HLS  $\phi 1.5 \times EL10$  mm

|                 |                         |
|-----------------|-------------------------|
| Spindle Speed   | 7,000 min <sup>-1</sup> |
| Feed Rate       | 230 mm/min              |
| $a_p$           | 0.025 mm                |
| $a_e$           | 1.2 mm                  |
| Coolant         | Air blow (Nozzle)       |
| Overhang Length | 18 mm                   |
| Pocket Size     | $\phi 7 \times 2$ mm    |
| Cycle Time      | 17 min                  |



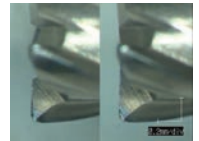
SKD11 (60HRC)



HLS 4 Flutes  $\phi 1.5 \times 10$

Diameter damage: 0.091 mm

1/3 and under!



Competitor: 4 Flutes  $\phi 1.5 \times 10$

Diameter damage: 0.296 mm



# Milling Conditions for HLS (4 Flutes)

4 Flutes

| WORK MATERIAL |                       |                       | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 |                                  |                                    | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                                 |                                  |                                    | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD (30~45HRC) |                                 |                                  |                                    | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                                 |                                  |                                    | HARDENED STEELS<br>SKD / SKH<br>(55~60HRC) |                                 |                                  |  |
|---------------|-----------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|------------------------------------|---|---------------------------------|----------------------------------|------------------------------------|---|---------------------------------|----------------------------------|------------------------------------|---|---------------------------------|----------------------------------|------------------------------------|--|---------------------------------|----------------------------------|--|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)                            | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)  | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)                                  | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)                         | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |  |
| 4010          | 1                     | 4                     | 24,700                                   | 1,180              | 0.04                            | 0.351                            | 21,000                             | 950   | 0.036                           | 0.332                            | 21,500                             | 660   | 0.028                           | 0.312                            | 17,200                             | 470   | 0.02                            | 0.293                            | 10,100                             | 240  | 0.01                            | 0.195                            |  |
|               |                       | 6                     | 22,800                                   | 1,060              | 0.024                           | 0.104                            | 19,400                             | 840   | 0.021                           | 0.099                            | 16,400                             | 590   | 0.016                           | 0.093                            | 13,100                             | 420   | 0.012                           | 0.087                            | 9,400                              | 210  | 0.007                           | 0.058                            |  |
|               |                       | 8                     | 20,900                                   | 950                | 0.021                           | 0.043                            | 17,800                             | 740   | 0.018                           | 0.041                            | 14,600                             | 500   | 0.014                           | 0.038                            | 11,700                             | 360   | 0.01                            | 0.036                            | 8,700                              | 190  | 0.006                           | 0.024                            |  |
|               |                       | 10                    | 19,100                                   | 840                | 0.018                           | 0.023                            | 16,200                             | 630   | 0.015                           | 0.022                            | 13,000                             | 450   | 0.013                           | 0.021                            | 10,400                             | 320   | 0.009                           | 0.02                             | 8,100                              | 160  | 0.005                           | 0.013                            |  |
|               |                       | 12                    | 17,300                                   | 730                | 0.015                           | 0.013                            | 14,700                             | 530   | 0.013                           | 0.012                            | 11,300                             | 380   | 0.011                           | 0.011                            | 9,000                              | 270   | 0.008                           | 0.011                            | 7,400                              | 130  | 0.004                           | 0.007                            |  |
|               |                       | 16                    | 13,500                                   | 500                | 0.009                           | 0.005                            | 11,500                             | 320   | 0.008                           | 0.005                            | 11,000                             | 220   | 0.007                           | 0.005                            | 8,800                              | 160   | 0.005                           | 0.005                            | 6,000                              | 80   | 0.003                           | 0.003                            |  |
| 4012          | 1.2                   | 6                     | 21,400                                   | 1,290              | 0.04                            | 0.216                            | 18,200                             | 1,020   | 0.034                           | 0.204                            | 15,400                             | 710   | 0.027                           | 0.192                            | 12,300                             | 510   | 0.019                           | 0.18                             | 8,900                              | 260  | 0.011                           | 0.12                             |  |
|               |                       | 8                     | 19,700                                   | 1,160              | 0.035                           | 0.092                            | 16,700                             | 890   | 0.03                            | 0.087                            | 13,800                             | 620   | 0.024                           | 0.082                            | 11,000                             | 440   | 0.017                           | 0.077                            | 8,200                              | 230  | 0.01                            | 0.051                            |  |
|               |                       | 10                    | 17,900                                   | 1,020              | 0.03                            | 0.047                            | 15,200                             | 770   | 0.026                           | 0.044                            | 12,100                             | 530   | 0.021                           | 0.042                            | 9,700                              | 380   | 0.015                           | 0.039                            | 7,600                              | 200  | 0.009                           | 0.026                            |  |
|               |                       | 12                    | 16,200                                   | 880                | 0.025                           | 0.027                            | 13,800                             | 640   | 0.021                           | 0.026                            | 10,500                             | 450   | 0.018                           | 0.024                            | 8,400                              | 320   | 0.013                           | 0.023                            | 6,900                              | 160  | 0.007                           | 0.015                            |  |
|               |                       | 16                    | 12,600                                   | 610                | 0.015                           | 0.011                            | 10,700                             | 330   | 0.013                           | 0.01                             | 9,900                              | 270   | 0.007                           | 0.01                             | 7,900                              | 190   | 0.005                           | 0.009                            | 5,600                              | 100  | 0.005                           | 0.006                            |  |
| 4014          | 1.4                   | 6                     | 20,200                                   | 1,440              | 0.068                           | 0.4                              | 17,200                             | 1,140   | 0.058                           | 0.377                            | 14,500                             | 800   | 0.046                           | 0.355                            | 11,600                             | 570   | 0.033                           | 0.333                            | 8,400                              | 290  | 0.019                           | 0.222                            |  |
|               |                       | 8                     | 19,000                                   | 1,290              | 0.06                            | 0.169                            | 16,200                             | 900   | 0.051                           | 0.16                             | 13,000                             | 690   | 0.041                           | 0.15                             | 10,400                             | 490   | 0.029                           | 0.141                            | 7,800                              | 260  | 0.017                           | 0.094                            |  |
|               |                       | 10                    | 17,000                                   | 1,140              | 0.051                           | 0.086                            | 14,500                             | 860   | 0.043                           | 0.082                            | 11,500                             | 600   | 0.036                           | 0.077                            | 9,200                              | 430   | 0.026                           | 0.072                            | 7,100                              | 220  | 0.014                           | 0.048                            |  |
|               |                       | 12                    | 15,300                                   | 990                | 0.043                           | 0.05                             | 13,000                             | 710   | 0.036                           | 0.048                            | 10,000                             | 500   | 0.03                            | 0.045                            | 8,000                              | 360   | 0.022                           | 0.042                            | 6,500                              | 180  | 0.012                           | 0.028                            |  |
|               |                       | 14                    | 13,700                                   | 840                | 0.034                           | 0.032                            | 11,600                             | 570   | 0.029                           | 0.031                            | 9,800                              | 410   | 0.025                           | 0.029                            | 7,800                              | 290   | 0.018                           | 0.027                            | 5,900                              | 140  | 0.01                            | 0.018                            |  |
|               |                       | 16                    | 11,900                                   | 680                | 0.026                           | 0.022                            | 10,100                             | 350   | 0.022                           | 0.02                             | 9,100                              | 310   | 0.02                            | 0.019                            | 7,300                              | 220   | 0.014                           | 0.018                            | 5,300                              | 110  | 0.008                           | 0.012                            |  |
|               |                       | 22                    | 9,000                                    | 340                | 0.013                           | 0.009                            | 6,000                              | 230   | 0.011                           | 0.009                            | 7,800                              | 170   | 0.01                            | 0.008                            | 6,200                              | 120   | 0.007                           | 0.008                            | 3,500                              | 50   | 0.001                           | 0.005                            |  |
| 4015          | 1.5                   | 6                     | 19,800                                   | 1,520              | 0.08                            | 0.527                            | 16,800                             | 1,200   | 0.068                           | 0.498                            | 14,300                             | 840   | 0.054                           | 0.469                            | 11,400                             | 600   | 0.039                           | 0.44                             | 8,200                              | 310  | 0.022                           | 0.293                            |  |
|               |                       | 8                     | 18,200                                   | 1,360              | 0.07                            | 0.223                            | 15,500                             | 930   | 0.06                            | 0.211                            | 12,800                             | 730   | 0.048                           | 0.198                            | 10,200                             | 520   | 0.034                           | 0.186                            | 7,600                              | 270  | 0.02                            | 0.124                            |  |
|               |                       | 10                    | 16,600                                   | 1,200              | 0.06                            | 0.113                            | 14,100                             | 900   | 0.051                           | 0.107                            | 11,300                             | 630   | 0.042                           | 0.101                            | 9,000                              | 450   | 0.03                            | 0.095                            | 7,000                              | 230  | 0.017                           | 0.063                            |  |
|               |                       | 12                    | 15,000                                   | 1,040              | 0.05                            | 0.067                            | 12,800                             | 720   | 0.043                           | 0.063                            | 9,800                              | 530   | 0.036                           | 0.059                            | 7,800                              | 380   | 0.026                           | 0.056                            | 6,400                              | 190  | 0.014                           | 0.037                            |  |
|               |                       | 14                    | 13,400                                   | 880                | 0.04                            | 0.041                            | 11,400                             | 600   | 0.034                           | 0.039                            | 9,500                              | 420   | 0.03                            | 0.037                            | 7,600                              | 300   | 0.021                           | 0.035                            | 5,800                              | 150  | 0.012                           | 0.023                            |  |
|               |                       | 16                    | 11,700                                   | 720                | 0.03                            | 0.027                            | 9,900                              | 370   | 0.026                           | 0.026                            | 8,900                              | 320   | 0.024                           | 0.024                            | 7,100                              | 230   | 0.017                           | 0.023                            | 5,200                              | 120  | 0.009                           | 0.015                            |  |
|               |                       | 18                    | 10,100                                   | 560                | 0.02                            | 0.02                             | 9,600                              | 310   | 0.017                           | 0.019                            | 8,400                              | 240   | 0.017                           | 0.018                            | 6,700                              | 170   | 0.012                           | 0.017                            | 4,600                              | 80   | 0.007                           | 0.011                            |  |
|               |                       | 20                    | 8,500                                    | 400                | 0.01                            | 0.014                            | 9,000                              | 280   | 0.011                           | 0.014                            | 7,900                              | 210   | 0.011                           | 0.013                            | 6,300                              | 150   | 0.008                           | 0.012                            | 4,000                              | 40   | 0.004                           | 0.008                            |  |
| 4016          | 1.6                   | 6                     | 19,200                                   | 1,670              | 0.08                            | 0.682                            | 15,100                             | 1,320   | 0.068                           | 0.644                            | 13,900                             | 920   | 0.054                           | 0.606                            | 11,100                             | 660   | 0.039                           | 0.569                            | 8,000                              | 340  | 0.022                           | 0.379                            |  |
|               |                       | 8                     | 17,000                                   | 1,500              | 0.07                            | 0.288                            | 15,000                             | 950   | 0.06                            | 0.272                            | 12,400                             | 800   | 0.048                           | 0.256                            | 9,900                              | 570   | 0.034                           | 0.24                             | 7,400                              | 300  | 0.02                            | 0.16                             |  |
|               |                       | 10                    | 16,100                                   | 1,320              | 0.06                            | 0.148                            | 12,700                             | 930   | 0.051                           | 0.139                            | 10,900                             | 700   | 0.042                           | 0.131                            | 8,700                              | 500   | 0.03                            | 0.123                            | 6,800                              | 250  | 0.017                           | 0.082                            |  |
|               |                       | 12                    | 14,500                                   | 1,140              | 0.05                            | 0.085                            | 11,500                             | 750   | 0.043                           | 0.08                             | 9,500                              | 590   | 0.036                           | 0.075                            | 7,600                              | 420   | 0.026                           | 0.071                            | 6,200                              | 210  | 0.014                           | 0.047                            |  |
|               |                       | 14                    | 13,000                                   | 970                | 0.04                            | 0.054                            | 10,300                             | 660   | 0.034                           | 0.051                            | 9,100                              | 460   | 0.03                            | 0.048                            | 7,300                              | 330   | 0.021                           | 0.045                            | 5,600                              | 170  | 0.012                           | 0.03                             |  |
|               |                       | 16                    | 11,400                                   | 790                | 0.03                            | 0.036                            | 9,500                              | 380   | 0.02                            | 0.034                            | 8,500                              | 350   | 0.024                           | 0.032                            | 6,800                              | 250   | 0.017                           | 0.03                             | 5,000                              | 130  | 0.009                           | 0.02                             |  |
|               |                       | 18                    | 9,800                                    | 620                | 0.02                            | 0.025                            | 9,300                              | 340   | 0.017                           | 0.024                            | 8,000                              | 250   | 0.017                           | 0.022                            | 6,400                              | 180   | 0.012                           | 0.021                            | 4,500                              | 80   | 0.007                           | 0.014                            |  |
|               |                       | 20                    | 8,200                                    | 440                | 0.011                           | 0.018                            | 8,700                              | 300   | 0.011                           | 0.017                            | 7,600                              | 220   | 0.011                           | 0.016                            | 6,100                              | 160   | 0.008                           | 0.015                            | 3,900                              | 40   | 0.004                           | 0.01                             |  |
|               |                       | 26                    | 8,000                                    | 300                | 0.007                           | 0.009                            | 7,400                              | 210   | 0.006                           | 0.009                            | 6,600                              | 170   | 0.006                           | 0.008                            | 5,300                              | 120   | 0.004                           | 0.008                            | 2,400                              | 20   | 0.002                           | 0.005                            |  |
| 4018          | 1.8                   | 6                     | 18,500                                   | 1,820              | 0.08                            | 1.094                            | 14,900                             | 1,440   | 0.068                           | 1.034                            | 13,300                             | 1,010   | 0.054                           | 0.973                            | 10,600                             | 720   | 0.039                           | 0.912                            | 7,600                              | 370  | 0.022                           | 0.608                            |  |
|               |                       | 8                     | 16,900                                   | 1,630              | 0.07                            | 0.461                            | 14,600                             | 980   | 0.06                            | 0.435                            | 11,900                             | 870   | 0.048                           | 0.41                             | 9,500                              | 620   | 0.034                           | 0.384                            | 7,100                              | 320  | 0.02                            | 0.256                            |  |
|               |                       | 10                    | 15,400                                   | 1,440              | 0.06                            | 0.236                            | 12,500                             | 950   | 0.051                           | 0.223                            | 10,500                             | 760   | 0.042                           | 0.21                             | 8,400                              | 540   | 0.03                            | 0.197                            | 6,500                              | 280  | 0.017                           | 0.131                            |  |
|               |                       | 12                    | 13,900                                   | 1,250              | 0.05                            | 0.137                            | 11,000                             | 770   | 0.043                           | 0.129                            | 9,100                              | 640   | 0.036                           | 0.122                            | 7,300                              | 460   | 0.026                           | 0.114                            | 6,000                              | 230  | 0.014                           | 0.076                            |  |
|               |                       | 14                    | 12,400                                   | 1,060              | 0.04                            | 0.086                            | 9,500                              | 720   | 0.034                           | 0.082                            | 8,400                              | 500   | 0.03                            | 0.077                            | 6,700                              | 360   | 0.021                           | 0.072                            | 5,400                              | 180  | 0.012                           | 0.048                            |  |
|               |                       | 16                    | 10,900                                   | 860                | 0.03                            | 0.058                            | 9,000                              | 450   | 0.026                           | 0.054                            | 7,900                              | 390   | 0.024                           | 0.051                            | 6,300                              | 280   | 0.017                           | 0.048                            | 4,800                              | 140  | 0.009                           | 0.032                            |  |
|               |                       | 18                    | 9,400                                    | 670                | 0.02                            | 0.041                            | 8,700                              | 380   | 0.017                           | 0.039                            | 7,400                              | 270   | 0.017                           | 0.037                            | 5,900                              | 190   | 0.012                           | 0.035                            | 4,300                              | 100  | 0.007                           | 0.023                            |  |
|               |                       | 20                    | 7,900                                    | 480                | 0.015                           | 0.029                            | 8,400                              | 340   | 0.013                           | 0.027                            | 7,000                              | 240   | 0.011                           | 0.026                            | 5,600                              | 170   | 0.008                           | 0.024                            | 3,700                              | 50   | 0.004                           | 0.016                            |  |
|               |                       | 25                    | 7,800                                    | 350                | 0.01                            | 0.014                            | 7,300                              | 260   | 0.008                           | 0.014                            | 6,300                              | 200   | 0.007                           | 0.013                            | 5,000                              | 140   | 0.005                           | 0.012                            | 2,400                              | 20   | 0.002                           | 0.008                            |  |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Square
  - Long Neck Square
- Radius
  - Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball
  - Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
  - Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Milling Conditions for HLS (4 Flutes)

| WORK MATERIAL |                       |                       | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD (30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKH<br>(55~60HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4020          | 2                     | 6                     | 17,900                                   | 1,980              | 0.08                            | 1.667                            | 14,500  | 1,560              | 0.068                           | 1.574                            | 12,900  | 1,090              | 0.054                           | 1.482                            | 10,300  | 780                | 0.039                           | 1.389                            | 7,400                                      | 400                | 0.022                           | 0.926                            |
|               |                       | 8                     | 16,400                                   | 1,770              | 0.07                            | 0.704                            | 14,200  | 1,000              | 0.06                            | 0.665                            | 11,500  | 950                | 0.048                           | 0.626                            | 9,200   | 680                | 0.034                           | 0.587                            | 6,800                                      | 350                | 0.02                            | 0.391                            |
|               |                       | 10                    | 14,900                                   | 1,560              | 0.06                            | 0.36                             | 12,000  | 980                | 0.051                           | 0.34                             | 10,100  | 830                | 0.042                           | 0.32                             | 8,100   | 590                | 0.03                            | 0.3                              | 6,300                                      | 300                | 0.017                           | 0.2                              |
|               |                       | 12                    | 13,500                                   | 1,350              | 0.05                            | 0.209                            | 10,500  | 790                | 0.043                           | 0.197                            | 8,800   | 690                | 0.036                           | 0.186                            | 7,000   | 490                | 0.026                           | 0.174                            | 5,800                                      | 250                | 0.014                           | 0.116                            |
|               |                       | 14                    | 12,000                                   | 1,140              | 0.04                            | 0.131                            | 9,400   | 780                | 0.034                           | 0.124                            | 8,300   | 550                | 0.03                            | 0.117                            | 6,600   | 390                | 0.021                           | 0.11                             | 5,200                                      | 200                | 0.012                           | 0.073                            |
|               |                       | 16                    | 10,600                                   | 940                | 0.03                            | 0.088                            | 9,000   | 500                | 0.026                           | 0.083                            | 7,600   | 420                | 0.024                           | 0.078                            | 6,100   | 300                | 0.017                           | 0.074                            | 4,700                                      | 160                | 0.009                           | 0.049                            |
|               |                       | 18                    | 9,100                                    | 730                | 0.022                           | 0.061                            | 8,700   | 420                | 0.02                            | 0.058                            | 7,300   | 290                | 0.017                           | 0.054                            | 5,800   | 210                | 0.012                           | 0.051                            | 4,100                                      | 100                | 0.007                           | 0.034                            |
|               |                       | 20                    | 7,700                                    | 520                | 0.018                           | 0.045                            | 8,100   | 380                | 0.016                           | 0.043                            | 6,900   | 270                | 0.013                           | 0.04                             | 5,500   | 190                | 0.009                           | 0.038                            | 3,600                                      | 50                 | 0.004                           | 0.025                            |
|               |                       | 25                    | 7,500                                    | 390                | 0.012                           | 0.023                            | 7,100   | 290                | 0.011                           | 0.022                            | 6,100   | 220                | 0.008                           | 0.021                            | 4,900   | 160                | 0.006                           | 0.02                             | 2,400                                      | 20                 | 0.002                           | 0.013                            |
|               |                       | 30                    | 7,000                                    | 310                | 0.008                           | 0.013                            | 6,300   | 230                | 0.007                           | 0.012                            | 5,600   | 180                | 0.006                           | 0.011                            | 4,500   | 130                | 0.004                           | 0.011                            | 2,400                                      | 10                 | 0.001                           | 0.007                            |
| 4025          | 2.5                   | 8                     |  |                    |                                 | 12,800                           | 1,020   | 0.081              | 1.622                           | 9,600                            | 980   | 0.055              | 1.526                           | 7,700                            | 700   | 0.039              | 1.431                           | 6,200                            | 370  | 0.023              | 0.954                           |                                  |
|               |                       | 12                    |  |                    |                                 | 10,000                           | 810   | 0.056              | 0.481                           | 7,900                            | 700   | 0.042              | 0.453                           | 6,300                            | 500   | 0.03               | 0.425                           | 5,600                            | 350  | 0.018              | 0.283                           |                                  |
|               |                       | 16                    |  |                    |                                 | 8,400                            | 590   | 0.04               | 0.202                           | 6,900                            | 450   | 0.031              | 0.19                            | 5,500                            | 320   | 0.022              | 0.179                           | 4,400                            | 320  | 0.013              | 0.119                           |                                  |
|               |                       | 20                    |  |                    |                                 | 7,300                            | 490   | 0.03               | 0.104                           | 6,500                            | 420   | 0.024              | 0.098                           | 5,200                            | 300   | 0.017              | 0.092                           | 3,500                            | 290  | 0.01               | 0.061                           |                                  |
|               |                       | 25                    |  |                    |                                 | 6,400                            | 390   | 0.019              | 0.053                           | 6,000                            | 380   | 0.015              | 0.05                            | 4,800                            | 270   | 0.011              | 0.047                           | 2,400                            | 250  | 0.005              | 0.031                           |                                  |
|               |                       | 30                    |  |                    |                                 | 5,700                            | 320   | 0.012              | 0.031                           | 4,400                            | 350   | 0.01               | 0.029                           | 3,500                            | 250   | 0.007              | 0.027                           | 2,300                            | 220  | 0.003              | 0.018                           |                                  |
| 4030          | 3                     | 8                     |  |                    |                                 | 10,900                           | 1,080   | 0.093              | 2.361                           | 7,400                            | 1,010   | 0.073              | 2.222                           | 5,900                            | 720   | 0.052              | 2.084                           | 5,900                            | 440  | 0.031              | 1.389                           |                                  |
|               |                       | 12                    |  |                    |                                 | 8,700                            | 830   | 0.073              | 0.996                           | 7,000                            | 730   | 0.057              | 0.938                           | 5,600                            | 520   | 0.041              | 0.879                           | 5,000                            | 400  | 0.024              | 0.586                           |                                  |
|               |                       | 16                    |  |                    |                                 | 7,400                            | 670   | 0.058              | 0.42                            | 6,000                            | 520   | 0.045              | 0.395                           | 5,300                            | 370   | 0.032              | 0.371                           | 4,000                            | 370  | 0.019              | 0.247                           |                                  |
|               |                       | 20                    |  |                    |                                 | 6,600                            | 560   | 0.045              | 0.216                           | 6,100                            | 490   | 0.035              | 0.203                           | 4,900                            | 350   | 0.025              | 0.191                           | 3,400                            | 340  | 0.015              | 0.127                           |                                  |
|               |                       | 25                    |  |                    |                                 | 5,800                            | 460   | 0.032              | 0.111                           | 5,600                            | 450   | 0.025              | 0.14                            | 4,500                            | 320   | 0.018              | 0.098                           | 2,400                            | 290  | 0.011              | 0.065                           |                                  |
|               |                       | 30                    |  |                    |                                 | 5,200                            | 390   | 0.023              | 0.065                           | 4,300                            | 410   | 0.02               | 0.061                           | 3,400                            | 290   | 0.014              | 0.057                           | 2,300                            | 250  | 0.009              | 0.038                           |                                  |
|               |                       | 40                    |  |                    |                                 | 4,500                            | 280   | 0.012              | 0.027                           | 4,100                            | 320   | 0.014              | 0.026                           | 3,300                            | 230   | 0.01               | 0.024                           | 2,000                            | 170  | 0.006              | 0.016                           |                                  |
|               |                       | 12                    |  |                    |                                 | 7,100                            | 950   | 0.101              | 3.148                           | 5,100                            | 740   | 0.101              | 2.963                           | 4,100                            | 530   | 0.072              | 2.778                           | 4,100                            | 460  | 0.043              | 1.852                           |                                  |
| 4040          | 4                     | 16                    |  |                    |                                 | 6,000                            | 770   | 0.084              | 1.328                           | 4,900                            | 600   | 0.092              | 1.25                            | 3,900                            | 430   | 0.066              | 1.172                           | 3,700                            | 420  | 0.04               | 0.781                           |                                  |
|               |                       | 20                    |  |                    |                                 | 5,200                            | 650   | 0.069              | 0.68                            | 4,500                            | 560   | 0.084              | 0.64                            | 3,600                            | 400   | 0.06               | 0.6                             | 3,300                            | 380  | 0.036              | 0.4                             |                                  |
|               |                       | 25                    |  |                    |                                 | 4,600                            | 540   | 0.055              | 0.349                           | 4,100                            | 520   | 0.076              | 0.328                           | 3,300                            | 370   | 0.054              | 0.308                           | 2,400                            | 340  | 0.032              | 0.205                           |                                  |
|               |                       | 30                    |  |                    |                                 | 4,100                            | 460   | 0.043              | 0.202                           | 3,800                            | 460   | 0.059              | 0.19                            | 3,000                            | 330   | 0.042              | 0.179                           | 2,300                            | 290  | 0.027              | 0.119                           |                                  |
|               |                       | 35                    |  |                    |                                 | 3,800                            | 400   | 0.034              | 0.128                           | 3,400                            | 420   | 0.05               | 0.12                            | 2,700                            | 300   | 0.036              | 0.113                           | 2,200                            | 240  | 0.023              | 0.075                           |                                  |
|               |                       | 40                    |  |                    |                                 | 3,500                            | 350   | 0.027              | 0.085                           | 3,000                            | 380   | 0.042              | 0.08                            | 2,400                            | 270   | 0.03               | 0.075                           | 1,900                            | 190  | 0.018              | 0.05                            |                                  |
|               |                       | 45                    |  |                    |                                 | 3,300                            | 300   | 0.021              | 0.06                            | 2,600                            | 320   | 0.025              | 0.056                           | 2,100                            | 230   | 0.018              | 0.053                           | 1,800                            | 140  | 0.014              | 0.035                           |                                  |
|               |                       | 50                    |  |                    |                                 | 3,100                            | 270   | 0.016              | 0.044                           | 2,300                            | 280   | 0.017              | 0.042                           | 1,800                            | 200   | 0.012              | 0.039                           | 1,700                            | 100  | 0.009              | 0.026                           |                                  |
| 4050          | 5                     | 16                    |  |                    |                                 | 5,100                            | 860   | 0.128              | 3.242                           | 4,100                            | 670   | 0.108              | 3.051                           | 3,300                            | 480   | 0.077              | 2.861                           | 3,300                            | 480  | 0.048              | 1.907                           |                                  |
|               |                       | 25                    |  |                    |                                 | 3,800                            | 600   | 0.102              | 0.85                            | 3,600                            | 570   | 0.088              | 0.8                             | 2,900                            | 410   | 0.063              | 0.75                            | 2,400                            | 380  | 0.037              | 0.5                             |                                  |
|               |                       | 35                    |  |                    |                                 | 3,100                            | 450   | 0.077              | 0.309                           | 2,900                            | 480   | 0.059              | 0.291                           | 2,300                            | 340   | 0.042              | 0.273                           | 2,000                            | 270  | 0.026              | 0.182                           |                                  |
|               |                       | 50                    |  |                    |                                 | 2,400                            | 300   | 0.034              | 0.107                           | 2,000                            | 320   | 0.022              | 0.101                           | 1,600                            | 230   | 0.016              | 0.095                           | 1,500                            | 110  | 0.01               | 0.063                           |                                  |
| 4060          | 6                     | 20                    |  |                    |                                 | 3,800                            | 780   | 0.17               | 3.443                           | 3,300                            | 700   | 0.139              | 3.24                            | 2,600                            | 500   | 0.099              | 3.038                           | 3,300                            | 610  | 0.06               | 2.025                           |                                  |
|               |                       | 30                    |  |                    |                                 | 2,800                            | 540   | 0.128              | 1.02                            | 2,800                            | 590   | 0.101              | 0.96                            | 2,200                            | 420   | 0.072              | 0.9                             | 2,200                            | 360  | 0.045              | 0.6                             |                                  |
|               |                       | 40                    |  |                    |                                 | 2,300                            | 410   | 0.085              | 0.43                            | 2,100                            | 460   | 0.063              | 0.405                           | 1,700                            | 330   | 0.045              | 0.38                            | 1,700                            | 240  | 0.03               | 0.253                           |                                  |
|               |                       | 50                    |  |                    |                                 | 1,900                            | 310   | 0.049              | 0.221                           | 1,600                            | 350   | 0.038              | 0.208                           | 1,300                            | 250   | 0.027              | 0.195                           | 1,300                            | 120  | 0.015              | 0.13                            |                                  |

Recommend  
2 flute HLS  
or C-CER.

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

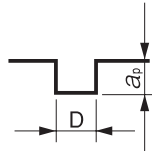
Drill

Technical Data



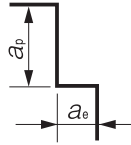
## Milling Conditions for HLS (4 Flutes)

Slotting



D : Outside Diameter (mm)

Side Milling



### Note:

- Recommend using a non-contact measuring device to avoid damaging the precision tip point.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Every coolant offers stable milling.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend wet coolant for Copper.

4 Flutes

∅3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 1 \sim \phi 12$

**CXS**

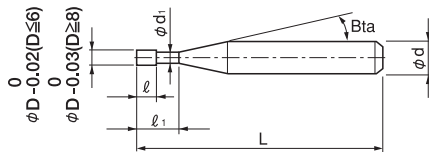


Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ○      |        |        |        | ○         |                 |          | ●      |          |                       | ○               | ○                     |                  |                                       |

**Features**

Variable Pitch & Helix design minimizes vibration and chattering.  
 Selected high toughness and chip resistant carbide material.  
 Optimized flute design offers outstanding high efficiency milling and fine finishing.  
 Low friction coating resulting in excellent chip evacuation and resistance to wear.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 33 models

Unit (mm)

| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $B_{ta}$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price $\text{¥}$ | Effective Length by Inclined Angles |       |       |       |                 |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|----------------------------|------------------|-------------------------|-----------------------------------|-------------------------------------|-------|-------|-------|-----------------|
|              |                           |                           |                      |                          |                            |                  |                         |                                   | 30'                                 | 1°    | 1°30' | 2°    | 3°              |
| CXS 4010-030 | 1                         | 3                         | 1.5                  | 0.96                     | 16°                        | 50               | 4                       | 6,520                             | 3.25                                | 3.35  | 3.47  | 3.59  | 3.86            |
| CXS 4010-050 |                           | 5                         |                      |                          |                            | 70               | 4                       | 6,920                             | 5.31                                | 5.48  | 5.67  | 5.87  | 6.31            |
| CXS 4010-060 |                           | 6                         |                      |                          |                            | 70               | 4                       | 7,110                             | 6.34                                | 6.55  | 6.77  | 7.00  | 7.53            |
| CXS 4015-045 | 1.5                       | 4.5                       | 2.25                 | 1.46                     | 16°                        | 50               | 4                       | 6,520                             | 4.66                                | 4.81  | 4.97  | 5.15  | 5.53            |
| CXS 4015-070 |                           | 7                         |                      |                          |                            | 70               | 4                       | 6,920                             | 7.23                                | 7.47  | 7.72  | 7.99  | 8.59            |
| CXS 4015-085 |                           | 8.5                       |                      |                          |                            | 70               | 4                       | 7,110                             | 8.78                                | 9.07  | 9.37  | 9.70  | 10.43           |
| CXS 4020-060 | 2                         | 6                         | 3                    | 1.94                     | 16°                        | 50               | 4                       | 6,100                             | 6.24                                | 6.44  | 6.66  | 6.89  | 7.41            |
| CXS 4020-090 |                           | 9                         |                      |                          |                            | 70               | 4                       | 6,480                             | 9.33                                | 9.64  | 9.96  | 10.31 | 11.08           |
| CXS 4020-110 |                           | 11                        |                      |                          |                            | 70               | 4                       | 6,650                             | 11.40                               | 11.77 | 12.16 | 12.59 | 13.53           |
| CXS 4025-075 | 2.5                       | 7.5                       | 3.75                 | 2.44                     | 16°                        | 50               | 4                       | 6,100                             | 7.79                                | 8.04  | 8.31  | 8.60  | 9.25            |
| CXS 4025-110 |                           | 11                        |                      |                          |                            | 70               | 4                       | 6,480                             | 11.40                               | 11.77 | 12.16 | 12.59 | 13.53           |
| CXS 4025-135 |                           | 13.5                      |                      |                          |                            | 70               | 4                       | 6,650                             | 13.97                               | 14.43 | 14.91 | 15.43 | No interference |

Unit (mm)

| Model Number | Outside Diameter $\phi D$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|--------------|---------------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|              |                           |                           |                      |                          |                           |                  |                         |                          | 30°                                 | 1°              | 1°30'           | 2°              | 3°              |
| CXS 4030-090 | 3                         | 9                         | 4.5                  | 2.95                     | 16°                       | 50               | 6                       | 7,000                    | 9.34                                | 9.64            | 9.97            | 10.31           | 11.09           |
| CXS 4030-130 |                           | 13                        |                      |                          |                           | 70               | 6                       | 7,430                    | 13.46                               | 13.90           | 14.37           | 14.87           | 15.98           |
| CXS 4030-160 |                           | 16                        |                      |                          |                           | 70               | 6                       | 7,630                    | 16.56                               | 17.10           | 17.67           | 18.28           | 19.65           |
| CXS 4040-120 | 4                         | 12                        | 6                    | 3.86                     | 16°                       | 50               | 6                       | 7,350                    | 12.61                               | 13.02           | 13.46           | 13.92           | 14.97           |
| CXS 4040-170 |                           | 17                        |                      |                          |                           | 70               | 6                       | 7,800                    | 17.76                               | 18.34           | 18.96           | 19.62           | No Interference |
| CXS 4040-210 |                           | 21                        |                      |                          |                           | 70               | 6                       | 8,010                    | 21.89                               | 22.60           | 23.36           | 24.17           | No Interference |
| CXS 4050-150 | 5                         | 15                        | 7.5                  | 4.86                     | 16°                       | 50               | 6                       | 7,900                    | 15.70                               | 16.21           | 16.76           | No Interference | No Interference |
| CXS 4050-210 |                           | 21                        |                      |                          |                           | 70               | 6                       | 8,380                    | 21.89                               | 22.60           | No Interference | No Interference | No Interference |
| CXS 4050-260 |                           | 26                        |                      |                          |                           | 70               | 6                       | 8,610                    | 27.05                               | 27.93           | No Interference | No Interference | No Interference |
| CXS 4060-180 | 6                         | 18                        | 9                    | 5.86                     | —                         | 50               | 6                       | 8,500                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CXS 4060-260 |                           | 26                        |                      |                          |                           | 70               | 6                       | 9,020                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CXS 4060-320 |                           | 32                        |                      |                          |                           | 70               | 6                       | 9,270                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CXS 4080-240 | 8                         | 24                        | 12                   | 7.82                     | —                         | 60               | 8                       | 10,500                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CXS 4080-340 |                           | 34                        |                      |                          |                           | 90               | 8                       | 11,140                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CXS 4080-420 |                           | 42                        |                      |                          |                           | 90               | 8                       | 11,450                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CXS 4100-300 | 10                        | 30                        | 15                   | 9.82                     | —                         | 70               | 10                      | 12,500                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CXS 4100-420 |                           | 42                        |                      |                          |                           | 100              | 10                      | 13,270                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CXS 4100-520 |                           | 52                        |                      |                          |                           | 100              | 10                      | 13,630                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CXS 4120-360 | 12                        | 36                        | 18                   | 11.82                    | —                         | 90               | 12                      | 17,800                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CXS 4120-520 |                           | 52                        |                      |                          |                           | 110              | 12                      | 18,880                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CXS 4120-620 |                           | 62                        |                      |                          |                           | 110              | 12                      | 19,400                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |

4 Flutes

3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper




Barrel

Spiral V Cutter

Drill

Technical Data

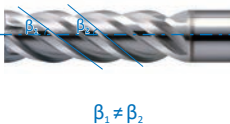
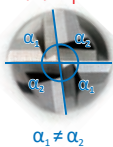
### 4 Flutes Square Variable Pitch and Helix 3 series

| Features                | Model Number    | Appearance  | Coating  | Size                  | Carbon Steels | Alloy Steels | Prehardened Steels | Hardened Steels |          |          |          |          | Aluminum Alloys | Titanium Alloys | Page |
|-------------------------|-----------------|---|----------|-----------------------|---------------|--------------|--------------------|-----------------|----------|----------|----------|----------|-----------------|-----------------|------|
|                         |                 |   |          |                       |               |              |                    | ~ 50 HRC        | ~ 55 HRC | ~ 60 HRC | ~ 65 HRC | ~ 70 HRC |                 |                 |      |
| High Efficiency         | CXES All flute  |  | UT COAT  | $\phi 1 \sim \phi 16$ | ●             | ●            | ●                  | ●               | ○        |          |          |          | ○               | 216             |      |
| High Efficiency         | CXS Long Neck   |  | UT COAT  | $\phi 1 \sim \phi 12$ | ●             | ●            | ●                  | ●               | ○        |          |          |          | ○               | 294             |      |
| High Efficiency for SUS | CESUS All flute |  | UTS COAT | $\phi 6 \sim \phi 12$ | ●             | ★            | ○                  |                 |          |          |          |          | ○               | 228             |      |

Variable pitch

Variable helix

(★ Highly Recommended ● Recommended ○ Suggested)



Minimizes chattering

Stable milling under highly efficient conditions

Milling Conditions for CXS

Side Milling

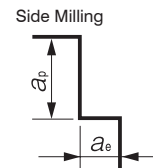
| WORK MATERIAL |                       |                       | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                                 |                                  | STAINLESS STEELS<br>SUS304<br>Use water soluble or oil coolant. |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-030      | 1                     | 3                     | 18,000  | 780                | 1                               | 0.3                              | 18,000   | 600                | 1                               | 0.3                              | 14,500  | 400                | 1                               | 0.3                              |
|               |                       | 5                     | 18,000  | 780                | 1                               | 0.23                             | 15,330   | 520                | 1                               | 0.23                             | 12,570  | 350                | 1                               | 0.23                             |
|               |                       | 6                     | 18,000  | 780                | 1                               | 0.2                              | 14,000   | 480                | 1                               | 0.2                              | 11,600  | 320                | 1                               | 0.2                              |
| 4015-045      | 1.5                   | 4.5                   | 13,500  | 970                | 1.5                             | 0.45                             | 13,500   | 750                | 1.5                             | 0.45                             | 13,300  | 420                | 1.5                             | 0.45                             |
|               |                       | 7                     | 13,500  | 970                | 1.5                             | 0.36                             | 11,810   | 660                | 1.5                             | 0.36                             | 11,610  | 360                | 1.5                             | 0.36                             |
|               |                       | 8.5                   | 13,500  | 970                | 1.5                             | 0.3                              | 10,800   | 600                | 1.5                             | 0.3                              | 10,600  | 330                | 1.5                             | 0.3                              |
| 4020-060      | 2                     | 6                     | 11,000  | 1,170              | 2                               | 0.6                              | 11,000   | 900                | 2                               | 0.6                              | 12,200  | 450                | 2                               | 0.6                              |
|               |                       | 9                     | 11,000  | 1,170              | 2                               | 0.48                             | 9,680  | 790                | 2                               | 0.48                             | 10,730  | 400                | 2                               | 0.48                             |
|               |                       | 11                    | 11,000  | 1,170              | 2                               | 0.4                              | 8,800  | 720                | 2                               | 0.4                              | 9,750   | 360                | 2                               | 0.4                              |
| 4025-075      | 2.5                   | 7.5                   | 9,500   | 1,180              | 2.5                             | 0.75                             | 9,500  | 900                | 2.5                             | 0.75                             | 11,000  | 550                | 2.5                             | 0.75                             |
|               |                       | 11                    | 9,500   | 1,180              | 2.5                             | 0.6                              | 8,390  | 800                | 2.5                             | 0.6                              | 9,720   | 490                | 2.5                             | 0.6                              |
|               |                       | 13.5                  | 9,500   | 1,180              | 2.5                             | 0.5                              | 7,600  | 720                | 2.5                             | 0.5                              | 8,800   | 440                | 2.5                             | 0.5                              |
| 4030-090      | 3                     | 9                     | 8,500   | 1,200              | 3                               | 0.9                              | 8,500  | 900                | 3                               | 0.9                              | 10,000  | 640                | 3                               | 0.9                              |
|               |                       | 13                    | 8,500   | 1,200              | 3                               | 0.73                             | 7,530  | 800                | 3                               | 0.73                             | 8,860   | 570                | 3                               | 0.73                             |
|               |                       | 16                    | 8,500   | 1,200              | 3                               | 0.6                              | 6,800  | 720                | 3                               | 0.6                              | 8,000   | 510                | 3                               | 0.6                              |
| 4040-120      | 4                     | 12                    | 7,200   | 1,350              | 4                               | 1.2                              | 6,700  | 1,000              | 4                               | 1.2                              | 7,500   | 730                | 4                               | 1.2                              |
|               |                       | 17                    | 7,200   | 1,350              | 4                               | 0.98                             | 5,920  | 890                | 4                               | 0.98                             | 6,670   | 650                | 4                               | 0.98                             |
|               |                       | 21                    | 7,200   | 1,350              | 4                               | 0.8                              | 5,300  | 800                | 4                               | 0.8                              | 6,000   | 580                | 4                               | 0.8                              |
| 4050-150      | 5                     | 15                    | 6,000   | 1,500              | 5                               | 1.5                              | 5,400  | 1,100              | 5                               | 1.5                              | 5,400   | 810                | 5                               | 1.5                              |
|               |                       | 21                    | 6,000   | 1,500              | 5                               | 1.23                             | 4,800  | 980                | 5                               | 1.23                             | 4,800   | 720                | 5                               | 1.23                             |
|               |                       | 26                    | 6,000   | 1,500              | 5                               | 1                                | 4,300  | 880                | 5                               | 1                                | 4,300   | 640                | 5                               | 1                                |
| 4060-180      | 6                     | 18                    | 5,000   | 1,600              | 6                               | 1.8                              | 4,500  | 1,200              | 6                               | 1.8                              | 4,500   | 810                | 6                               | 1.8                              |
|               |                       | 26                    | 5,000   | 1,600              | 6                               | 1.46                             | 3,990  | 1,060              | 6                               | 1.46                             | 3,990   | 710                | 6                               | 1.46                             |
|               |                       | 32                    | 5,000   | 1,600              | 6                               | 1.2                              | 3,600  | 960                | 6                               | 1.2                              | 3,600   | 640                | 6                               | 1.2                              |
| 4080-240      | 8                     | 24                    | 3,000   | 1,300              | 8                               | 2.4                              | 2,900  | 1,050              | 8                               | 2.4                              | 2,900   | 720                | 8                               | 2.4                              |
|               |                       | 34                    | 3,000   | 1,300              | 8                               | 1.96                             | 2,570  | 930                | 8                               | 1.96                             | 2,570   | 640                | 8                               | 1.96                             |
|               |                       | 42                    | 3,000   | 1,300              | 8                               | 1.6                              | 2,300  | 840                | 8                               | 1.6                              | 2,300   | 570                | 8                               | 1.6                              |
| 4100-300      | 10                    | 30                    | 1,600   | 1,000              | 10                              | 3                                | 1,500  | 900                | 10                              | 3                                | 1,500   | 580                | 10                              | 3                                |
|               |                       | 42                    | 1,600   | 1,000              | 10                              | 2.45                             | 1,340  | 800                | 10                              | 2.45                             | 1,340   | 510                | 10                              | 2.45                             |
|               |                       | 52                    | 1,600   | 1,000              | 10                              | 2                                | 1,200  | 720                | 10                              | 2                                | 1,200   | 460                | 10                              | 2                                |
| 4120-360      | 12                    | 36                    | 1,200   | 800                | 12                              | 3.6                              | 1,200  | 750                | 12                              | 3.6                              | 1,200   | 540                | 12                              | 3.6                              |
|               |                       | 52                    | 1,200   | 800                | 12                              | 2.86                             | 1,050  | 660                | 12                              | 2.86                             | 1,050   | 470                | 12                              | 2.86                             |
|               |                       | 62                    | 1,200   | 800                | 12                              | 2.4                              | 950  | 600                | 12                              | 2.4                              | 950   | 430                | 12                              | 2.4                              |

# Milling Conditions for CXS

4 Flutes

| WORK MATERIAL |                       |                       | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                        |                         | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                        |                         |
|---------------|-----------------------|-----------------------|---|--------------------|------------------------|-------------------------|---|--------------------|------------------------|-------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 4010-030      | 1                     | 3                     | 12,900  | 400                | 1                      | 0.3                     | 12,900  | 180                | 1                      | 0.15                    |
| 4010-050      |                       | 5                     | 11,170  | 350                | 1                      | 0.23                    | 12,900  | 180                | 1                      | 0.12                    |
| 4010-060      |                       | 6                     | 10,300  | 320                | 1                      | 0.2                     | 12,900  | 180                | 1                      | 0.1                     |
| 4015-045      | 1.5                   | 4.5                   | 10,500  | 500                | 1.5                    | 0.45                    | 9,500   | 280                | 1.5                    | 0.225                   |
| 4015-070      |                       | 7                     | 9,190   | 440                | 1.5                    | 0.36                    | 9,500   | 280                | 1.5                    | 0.18                    |
| 4015-085      |                       | 8.5                   | 8,400   | 400                | 1.5                    | 0.3                     | 9,500   | 280                | 1.5                    | 0.15                    |
| 4020-060      | 2                     | 6                     | 9,350   | 560                | 2                      | 0.6                     | 8,200   | 390                | 2                      | 0.3                     |
| 4020-090      |                       | 9                     | 8,210   | 490                | 2                      | 0.48                    | 8,200   | 390                | 2                      | 0.24                    |
| 4020-110      |                       | 11                    | 7,450   | 440                | 2                      | 0.4                     | 8,200   | 390                | 2                      | 0.2                     |
| 4025-075      | 2.5                   | 7.5                   | 8,300   | 610                | 2.5                    | 0.75                    | 7,800   | 510                | 2.5                    | 0.375                   |
| 4025-110      |                       | 11                    | 7,340   | 530                | 2.5                    | 0.6                     | 7,800   | 510                | 2.5                    | 0.3                     |
| 4025-135      |                       | 13.5                  | 6,650   | 480                | 2.5                    | 0.5                     | 7,800   | 510                | 2.5                    | 0.25                    |
| 4030-090      | 3                     | 9                     | 7,400   | 630                | 3                      | 0.9                     | 7,400   | 630                | 3                      | 0.45                    |
| 4030-130      |                       | 13                    | 6,540   | 560                | 3                      | 0.73                    | 7,400   | 630                | 3                      | 0.36                    |
| 4030-160      |                       | 16                    | 5,900   | 500                | 3                      | 0.6                     | 7,400   | 630                | 3                      | 0.3                     |
| 4040-120      | 4                     | 12                    | 5,900   | 650                | 4                      | 1.2                     | 5,900   | 650                | 4                      | 0.6                     |
| 4040-170      |                       | 17                    | 5,230   | 580                | 4                      | 0.98                    | 5,900   | 650                | 4                      | 0.49                    |
| 4040-210      |                       | 21                    | 4,700   | 520                | 4                      | 0.8                     | 5,900   | 650                | 4                      | 0.4                     |
| 4050-150      | 5                     | 15                    | 4,800   | 680                | 5                      | 1.5                     | 4,800   | 670                | 5                      | 0.75                    |
| 4050-210      |                       | 21                    | 4,250   | 600                | 5                      | 1.23                    | 4,800   | 670                | 5                      | 0.61                    |
| 4050-260      |                       | 26                    | 3,800   | 540                | 5                      | 1                       | 4,800   | 670                | 5                      | 0.5                     |
| 4060-180      | 6                     | 18                    | 4,000   | 680                | 6                      | 1.8                     | 4,000   | 680                | 6                      | 0.9                     |
| 4060-260      |                       | 26                    | 3,540   | 600                | 6                      | 1.46                    | 4,000   | 680                | 6                      | 0.73                    |
| 4060-320      |                       | 32                    | 3,200   | 540                | 6                      | 1.2                     | 4,000   | 680                | 6                      | 0.6                     |
| 4080-240      | 8                     | 24                    | 2,500   | 600                | 8                      | 2.4                     | 2,500   | 630                | 8                      | 1.2                     |
| 4080-340      |                       | 34                    | 2,220   | 530                | 8                      | 1.96                    | 2,500   | 630                | 8                      | 0.98                    |
| 4080-420      |                       | 42                    | 2,000   | 480                | 8                      | 1.6                     | 2,500   | 630                | 8                      | 0.8                     |
| 4100-300      | 10                    | 30                    | 1,500   | 430                | 10                     | 3                       | 1,500   | 570                | 10                     | 1.5                     |
| 4100-420      |                       | 42                    | 1,340   | 380                | 10                     | 2.45                    | 1,500   | 570                | 10                     | 1.23                    |
| 4100-520      |                       | 52                    | 1,200   | 340                | 10                     | 2                       | 1,500   | 570                | 10                     | 1                       |
| 4120-360      | 12                    | 36                    | 1,000   | 320                | 12                     | 3.6                     | 1,200   | 530                | 12                     | 1.8                     |
| 4120-520      |                       | 52                    | 880   | 280                | 12                     | 2.86                    | 1,200   | 500                | 12                     | 1.43                    |
| 4120-620      |                       | 62                    | 800   | 250                | 12                     | 2.4                     | 1,200   | 480                | 12                     | 1.2                     |

- $\varnothing 3\text{mm}$  Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Milling Conditions for CXS

Slotting

| WORK MATERIAL |                       |                       | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                                 | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                                 | STAINLESS STEELS<br>SUS304<br>Use water soluble or oil coolant. |                    |                                 |
|---------------|-----------------------|-----------------------|---|--------------------|---------------------------------|--|--------------------|---------------------------------|---|--------------------|---------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 4010-030      | 1                     | 3                     | 18,000  | 300                | 1                               | 18,000   | 300                | 1                               | 14,500  | 280                | 0.5                             |
| 4010-050      |                       | 5                     | 18,000  | 300                | 0.67                            | 15,330   | 260                | 0.67                            | 12,570  | 240                | 0.37                            |
| 4010-060      |                       | 6                     | 18,000  | 300                | 0.5                             | 14,000   | 240                | 0.5                             | 11,600  | 220                | 0.3                             |
| 4015-045      | 1.5                   | 4.5                   | 13,500  | 450                | 1.5                             | 13,500   | 400                | 1.5                             | 13,300  | 300                | 0.75                            |
| 4015-070      |                       | 7                     | 13,500  | 450                | 1.03                            | 11,810   | 350                | 1.03                            | 11,610  | 260                | 0.56                            |
| 4015-085      |                       | 8.5                   | 13,500  | 450                | 0.75                            | 10,800   | 320                | 0.75                            | 10,600  | 240                | 0.45                            |
| 4020-060      | 2                     | 6                     | 11,000  | 600                | 2                               | 11,000   | 400                | 2                               | 12,200  | 320                | 1                               |
| 4020-090      |                       | 9                     | 11,000  | 600                | 1.4                             | 9,680  | 350                | 1.4                             | 10,730  | 280                | 0.76                            |
| 4020-110      |                       | 11                    | 11,000  | 600                | 1                               | 8,800  | 320                | 1                               | 9,750   | 250                | 0.6                             |
| 4025-075      | 2.5                   | 7.5                   | 9,500   | 600                | 2.5                             | 9,500  | 400                | 2.5                             | 11,000  | 340                | 1.25                            |
| 4025-110      |                       | 11                    | 9,500   | 600                | 1.77                            | 8,390  | 350                | 1.77                            | 9,720   | 300                | 0.96                            |
| 4025-135      |                       | 13.5                  | 9,500   | 600                | 1.25                            | 7,600  | 320                | 1.25                            | 8,800   | 270                | 0.75                            |
| 4030-090      | 3                     | 9                     | 8,500   | 600                | 3                               | 8,500  | 400                | 3                               | 10,000  | 360                | 1.5                             |
| 4030-130      |                       | 13                    | 8,500   | 600                | 2.57                            | 7,530  | 350                | 2.14                            | 8,860   | 310                | 1.16                            |
| 4030-160      |                       | 16                    | 8,500   | 600                | 2.25                            | 6,800  | 320                | 1.5                             | 8,000   | 280                | 0.9                             |
| 4040-120      | 4                     | 12                    | 7,200   | 650                | 4                               | 6,700  | 450                | 4                               | 7,500   | 400                | 2                               |
| 4040-170      |                       | 17                    | 7,200   | 650                | 3.44                            | 5,920  | 400                | 2.89                            | 6,670   | 360                | 1.56                            |
| 4040-210      |                       | 21                    | 7,200   | 650                | 3                               | 5,300  | 360                | 2                               | 6,000   | 320                | 1.2                             |
| 4050-150      | 5                     | 15                    | 6,000   | 700                | 5                               | 5,400  | 500                | 5                               | 5,400   | 460                | 2.5                             |
| 4050-210      |                       | 21                    | 6,000   | 700                | 4.32                            | 4,800  | 450                | 3.64                            | 4,800   | 410                | 1.95                            |
| 4050-260      |                       | 26                    | 6,000   | 700                | 3.75                            | 4,300  | 400                | 2.5                             | 4,300   | 360                | 1.5                             |
| 4060-180      | 6                     | 18                    | 5,000   | 700                | 6                               | 4,500  | 500                | 6                               | 4,500   | 460                | 3                               |
| 4060-260      |                       | 26                    | 5,000   | 700                | 5.14                            | 3,990  | 440                | 4.29                            | 3,990   | 400                | 2.31                            |
| 4060-320      |                       | 32                    | 5,000   | 700                | 4.5                             | 3,600  | 400                | 3                               | 3,600   | 360                | 1.8                             |
| 4080-240      | 8                     | 24                    | 3,000   | 500                | 8                               | 2,900  | 360                | 8                               | 2,900   | 360                | 4                               |
| 4080-340      |                       | 34                    | 3,000   | 500                | 6.89                            | 2,570  | 320                | 5.78                            | 2,570   | 320                | 3.11                            |
| 4080-420      |                       | 42                    | 3,000   | 500                | 6                               | 2,300  | 280                | 4                               | 2,300   | 280                | 2.4                             |
| 4100-300      | 10                    | 30                    | 1,600   | 380                | 10                              | 1,500  | 270                | 10                              | 1,500   | 220                | 5                               |
| 4100-420      |                       | 42                    | 1,600   | 380                | 8.64                            | 1,340  | 240                | 7.27                            | 1,340   | 190                | 3.91                            |
| 4100-520      |                       | 52                    | 1,600   | 380                | 7.5                             | 1,200  | 210                | 5                               | 1,200   | 170                | 3                               |
| 4120-360      | 12                    | 36                    | 1,200   | 300                | 12                              | 1,200  | 210                | 12                              | 1,200   | 180                | 6                               |
| 4120-520      |                       | 52                    | 1,200   | 300                | 10.15                           | 1,050  | 180                | 8.31                            | 1,050   | 160                | 4.52                            |
| 4120-620      |                       | 62                    | 1,200   | 300                | 9                               | 950  | 160                | 6                               | 950   | 140                | 3.6                             |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

## Milling Conditions for CXS

4 Flutes

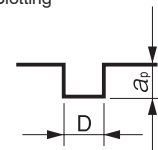
| WORK MATERIAL |                       |                       | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                                 | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                                 |
|---------------|-----------------------|-----------------------|---|--------------------|---------------------------------|---|--------------------|---------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 4010-030      | 1                     | 3                     | 12,900  | 170                | 1                               | 12,900  | 60                 | 0.25                            |
| 4010-050      |                       | 5                     | 11,170  | 140                | 0.67                            | setting disable                                     | setting disable    | setting disable                 |
| 4010-060      |                       | 6                     | 10,300  | 130                | 0.5                             | setting disable                                     | setting disable    | setting disable                 |
| 4015-045      | 1.5                   | 4.5                   | 10,500  | 230                | 1.5                             | 9,500   | 120                | 0.375                           |
| 4015-070      |                       | 7                     | 9,190   | 200                | 1.03                            | setting disable                                     | setting disable    | setting disable                 |
| 4015-085      |                       | 8.5                   | 8,400   | 180                | 0.75                            | setting disable                                     | setting disable    | setting disable                 |
| 4020-060      | 2                     | 6                     | 9,350   | 280                | 2                               | 8,200   | 180                | 0.5                             |
| 4020-090      |                       | 9                     | 8,210   | 240                | 1.4                             | setting disable                                     | setting disable    | setting disable                 |
| 4020-110      |                       | 11                    | 7,450   | 220                | 1                               | setting disable                                     | setting disable    | setting disable                 |
| 4025-075      | 2.5                   | 7.5                   | 8,300   | 300                | 2.5                             | 7,800   | 270                | 0.625                           |
| 4025-110      |                       | 11                    | 7,340   | 270                | 1.77                            | setting disable                                     | setting disable    | setting disable                 |
| 4025-135      |                       | 13.5                  | 6,650   | 240                | 1.25                            | setting disable                                     | setting disable    | setting disable                 |
| 4030-090      | 3                     | 9                     | 7,400   | 320                | 3                               | 7,400   | 360                | 1.5                             |
| 4030-130      |                       | 13                    | 6,540   | 280                | 2.14                            | setting disable                                     | setting disable    | setting disable                 |
| 4030-160      |                       | 16                    | 5,900   | 250                | 1.5                             | setting disable                                     | setting disable    | setting disable                 |
| 4040-120      | 4                     | 12                    | 5,900   | 390                | 4                               | 5,900   | 380                | 2                               |
| 4040-170      |                       | 17                    | 5,230   | 350                | 2.89                            | setting disable                                     | setting disable    | setting disable                 |
| 4040-210      |                       | 21                    | 4,700   | 310                | 2                               | setting disable                                     | setting disable    | setting disable                 |
| 4050-150      | 5                     | 15                    | 4,800   | 440                | 5                               | 4,800   | 410                | 2.5                             |
| 4050-210      |                       | 21                    | 4,250   | 390                | 3.64                            | setting disable                                     | setting disable    | setting disable                 |
| 4050-260      |                       | 26                    | 3,800   | 350                | 2.5                             | setting disable                                     | setting disable    | setting disable                 |
| 4060-180      | 6                     | 18                    | 4,000   | 440                | 6                               | 4,000   | 440                | 3                               |
| 4060-260      |                       | 26                    | 3,540   | 390                | 4.29                            | setting disable                                     | setting disable    | setting disable                 |
| 4060-320      |                       | 32                    | 3,200   | 350                | 3                               | setting disable                                     | setting disable    | setting disable                 |
| 4080-240      | 8                     | 24                    | 2,500   | 390                | 8                               | 2,500   | 340                | 4                               |
| 4080-340      |                       | 34                    | 2,220   | 350                | 5.78                            | setting disable                                     | setting disable    | setting disable                 |
| 4080-420      |                       | 42                    | 2,000   | 310                | 4                               | setting disable                                     | setting disable    | setting disable                 |
| 4100-300      | 10                    | 30                    | 1,500   | 220                | 10                              | 1,500   | 240                | 5                               |
| 4100-420      |                       | 42                    | 1,340   | 190                | 7.27                            | setting disable                                     | setting disable    | setting disable                 |
| 4100-520      |                       | 52                    | 1,200   | 170                | 5                               | setting disable                                     | setting disable    | setting disable                 |
| 4120-360      | 12                    | 36                    | 1,000   | 180                | 12                              | 1,200   | 220                | 6                               |
| 4120-520      |                       | 52                    | 880   | 160                | 8.31                            | setting disable                                     | setting disable    | setting disable                 |
| 4120-620      |                       | 62                    | 800   | 140                | 6                               | setting disable                                     | setting disable    | setting disable                 |

Contact our sales when milling hardened steels with L/D=5 or longer effective length tools.

**Note:**

- Decrease both spindle speed and feed rate proportionally in case of chattering.
- These milling parameters are calculated based on the shortest overhang length. Longer overhangs may require an adjustment to the milling parameters.
- Reduce the milling amount and feed rate in accordance with required milling precision.
- Every coolant offers stable milling.
- Recommend water soluble or oil coolant for Stainless Steels and Copper.

Slotting

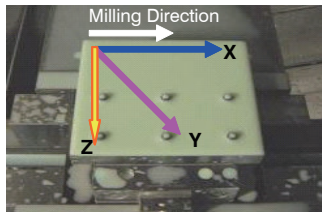


D : Outside Diameter (mm)

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Long Neck Square
- Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball
  - Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

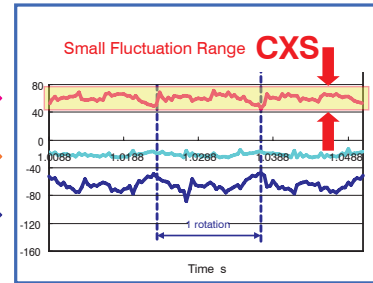
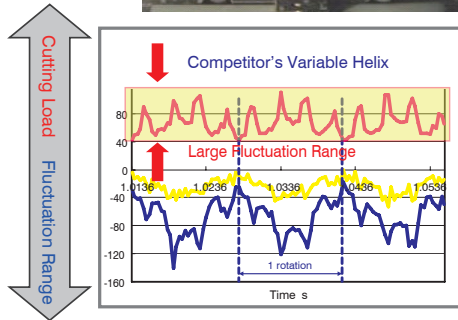
Cutting Load Comparison CXS  $\phi$  8

SKD61 (50HRC)



◆Milling Conditions

|               |                         |
|---------------|-------------------------|
| Spindle Speed | 4,200 min <sup>-1</sup> |
| Feed Rate     | 770 mm/min              |
| $a_p$         | 8 mm                    |
| $a_e$         | 0.3 mm                  |
| Coolant       | Water Soluble           |



Tool damage and surface quality will be influenced by the cutting load fluctuation range.

CXS has a small fluctuation range and the tool is hard to chatter.

High Efficiency Milling Example CXS  $\phi$  8

SUS304

|            |                        |                        |
|------------|------------------------|------------------------|
| <b>CXS</b> | Competitor A: Roughing | Competitor B: Roughing |
|            |                        |                        |
|            |                        |                        |
|            |                        |                        |

◆Milling Conditions

|                  |                         |
|------------------|-------------------------|
| Spindle Speed    | 5,000 min <sup>-1</sup> |
| Feed Rate        | 600 mm/min              |
| $a_p$            | 8 mm                    |
| $a_e$            | 3 mm                    |
| Coolant          | Water Soluble           |
| Milling Distance | 5.4 m                   |

※Using company B's milling condition




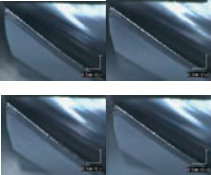




No tool damage on peripheral flute.

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



## Milling Example by Different Work Materials ① CXS $\phi$ 8

SKD61 (50HRC)

|   |   |   |                                  |
|---|---|---|----------------------------------|
| <p><b>CXS</b></p>   | <p>Competitor A: Variable Helix</p>   | <p>Competitor B: Variable Helix</p>   |                                  |
|   | <p>Milling Distance<br/><b>77 m</b></p>   | <p>Milling Distance<br/>44 m</p>  | <p>Milling Distance<br/>22 m</p> |

### ◆Milling Conditions

|               |                         |
|---------------|-------------------------|
| Spindle Speed | 4,200 min <sup>-1</sup> |
| Feed Rate     | <b>770 mm/min</b>       |
| $a_p$         | 8 mm                    |
| $a_e$         | <b>1 mm</b>             |
| Coolant       | Water Soluble           |

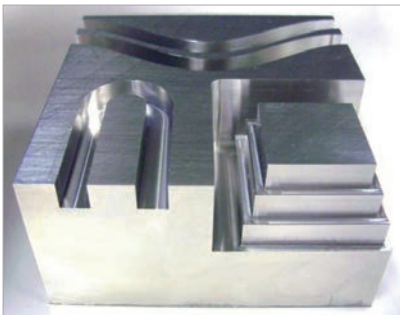
※Using company B's milling condition



Designed for a heavy roughing cut, even up to 50HRC

## Milling Example by Different Work Materials ② CXS $\phi$ 8

SUS304



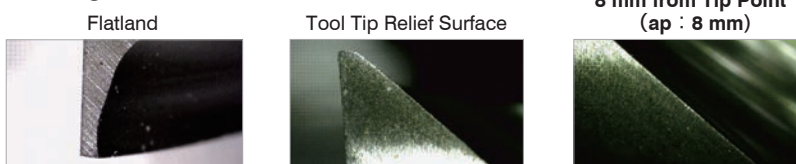
Size : 100 × 100 × 50 mm

### ◆Milling Conditions

|                |  |
|----------------|--|
| Milling Method | Side Milling, Slotting (One Direction)             |
| Spindle Speed  | 2,900 min <sup>-1</sup>                            |
| Feed Rate      | 360 mm/min (Slotting)<br>720 mm/min (Side Milling) |
| $a_p$          | <b>8 mm (1D)</b>                                   |
| $a_e$          | 2.4 mm   |
| Coolant        | Water Soluble                                      |
| Cycle Time     | <b>5 min</b>                                       |

High efficiency milling of difficult-to-cut material (SUS304).

### ◆Tool after Milling



Excellent tool life for high efficiency milling and finishing process.

CXS Series  
SUS304  
Milling Video



4 Flutes

$\phi$ 3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 1 \sim \phi 12$

**C-CRS**



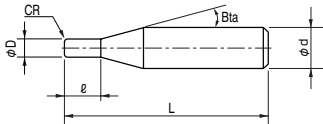
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        |           |                 |          | ●      |          |                       | ○               | ○                     |                  |                                       |

**Features**

Various range of Corner Radius.

Broad application range from Copper and Carbon Steels up to Hardened Steels (55HRC).



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 46 models

Unit (mm)

| Model Number         | Outside Diameter $\phi D$ | Corner Radius CR | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------------|---------------------------|------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| <b>C-CRS 2010-02</b> | 1                         | RO.2             | 2                    | 16°                   | 45               | 4                       | 7,900                    |
| <b>C-CRS 2010-03</b> |                           | RO.3             |                      |                       | 45               | 4                       | 7,900                    |
| <b>C-CRS 2015-02</b> | 1.5                       | RO.2             | 3                    | 16°                   | 45               | 4                       | 7,900                    |
| <b>C-CRS 2015-03</b> |                           | RO.3             |                      |                       | 45               | 4                       | 7,900                    |
| <b>C-CRS 2015-05</b> |                           | RO.5             |                      |                       | 45               | 4                       | 7,900                    |
| <b>C-CRS 2020-02</b> | 2                         | RO.2             | 4                    | 16°                   | 45               | 4                       | 7,900                    |
| <b>C-CRS 2020-03</b> |                           | RO.3             |                      |                       | 45               | 4                       | 7,900                    |
| <b>C-CRS 2020-05</b> |                           | RO.5             |                      |                       | 45               | 4                       | 7,900                    |
| <b>C-CRS 2025-02</b> | 2.5                       | RO.2             | 5                    | 16°                   | 45               | 4                       | 7,900                    |
| <b>C-CRS 2025-03</b> |                           | RO.3             |                      |                       | 45               | 4                       | 7,900                    |
| <b>C-CRS 2025-05</b> |                           | RO.5             |                      |                       | 45               | 4                       | 8,600                    |
| <b>C-CRS 2030-02</b> | 3                         | RO.2             | 10                   | 16°                   | 45               | 6                       | 9,030                    |
| <b>C-CRS 2030-03</b> |                           | RO.3             |                      |                       | 45               | 6                       | 9,030                    |
| <b>C-CRS 2030-05</b> |                           | RO.5             |                      |                       | 45               | 6                       | 9,980                    |
| <b>C-CRS 2030-10</b> |                           | R1               |                      |                       | 45               | 6                       | 10,710                   |

Next Page ➔

Unit (mm)

| Model Number  | Outside Diameter $\phi D$ | Corner Radius CR | Length of Cut $l$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|---------------|---------------------------|------------------|-------------------|-----------------------|------------------|-------------------------|--------------------------|
| C-CRS 2040-02 | 4                         | R0.2             | 12                | 16°                   | 45               | 6                       | 9,140                    |
| C-CRS 2040-03 |                           | R0.3             |                   |                       | 45               | 6                       | 9,140                    |
| C-CRS 2040-05 |                           | R0.5             |                   |                       | 45               | 6                       | 10,080                   |
| C-CRS 2040-10 |                           | R1               |                   |                       | 45               | 6                       | 10,820                   |
| C-CRS 2050-02 | 5                         | R0.2             | 15                | 16°                   | 50               | 6                       | 9,240                    |
| C-CRS 2050-03 |                           | R0.3             |                   |                       | 50               | 6                       | 9,240                    |
| C-CRS 2050-05 |                           | R0.5             |                   |                       | 50               | 6                       | 10,190                   |
| C-CRS 2050-10 |                           | R1               |                   |                       | 50               | 6                       | 10,920                   |
| C-CRS 2060-02 | 6                         | R0.2             | 15                | —                     | 50               | 6                       | 10,190                   |
| C-CRS 2060-03 |                           | R0.3             |                   |                       | 50               | 6                       | 10,190                   |
| C-CRS 2060-05 |                           | R0.5             |                   |                       | 50               | 6                       | 10,400                   |
| C-CRS 2060-10 |                           | R1               |                   |                       | 50               | 6                       | 11,130                   |
| C-CRS 2060-15 |                           | R1.5             |                   |                       | 50               | 6                       | 11,550                   |
| C-CRS 2060-20 |                           | R2               |                   |                       | 50               | 6                       | 11,870                   |
| C-CRS 2080-05 | 8                         | R0.5             | 20                | —                     | 60               | 8                       | 14,740                   |
| C-CRS 2080-10 |                           | R1               |                   |                       | 60               | 8                       | 15,510                   |
| C-CRS 2080-15 |                           | R1.5             |                   |                       | 60               | 8                       | 15,950                   |
| C-CRS 2080-20 |                           | R2               |                   |                       | 60               | 8                       | 16,280                   |
| C-CRS 2080-25 |                           | R2.5             |                   |                       | 60               | 8                       | 16,720                   |
| C-CRS 2100-05 | 10                        | R0.5             | 25                | —                     | 70               | 10                      | 19,140                   |
| C-CRS 2100-10 |                           | R1               |                   |                       | 70               | 10                      | 19,910                   |
| C-CRS 2100-15 |                           | R1.5             |                   |                       | 70               | 10                      | 20,350                   |
| C-CRS 2100-20 |                           | R2               |                   |                       | 70               | 10                      | 20,680                   |
| C-CRS 2100-25 |                           | R2.5             |                   |                       | 70               | 10                      | 21,120                   |
| C-CRS 2100-30 |                           | R3               |                   |                       | 70               | 10                      | 21,120                   |
| C-CRS 2120-05 | 12                        | R0.5             | 25                | —                     | 75               | 12                      | 23,980                   |
| C-CRS 2120-10 |                           | R1               |                   |                       | 75               | 12                      | 24,750                   |
| C-CRS 2120-15 |                           | R1.5             |                   |                       | 75               | 12                      | 25,190                   |
| C-CRS 2120-20 |                           | R2               |                   |                       | 75               | 12                      | 25,520                   |
| C-CRS 2120-25 |                           | R2.5             |                   |                       | 75               | 12                      | 25,960                   |
| C-CRS 2120-30 |                           | R3               |                   |                       | 75               | 12                      | 25,960                   |

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral  
V Cutter

Spiral  
V Cutter

Drill

Drill

Technical Data

Technical Data

## Milling Conditions for C-CRS

| WORK MATERIAL |                       | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                                 | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                                 |
|---------------|-----------------------|--|--------------------|---------------------------------|---|--------------------|---------------------------------|
| Model Number  | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| <b>2010</b>   | <b>1</b>              | 16,000                                   | 340                | 0.25                            | 12,700  | 120                | 0.25                            |
| <b>2020</b>   | <b>2</b>              | 8,000                                    | 200                | 0.5                             | 6,400   | 120                | 0.5                             |
| <b>2025</b>   | <b>2.5</b>            | 6,300                                    | 200                | 0.63                            | 5,100   | 120                | 0.63                            |
| <b>2030</b>   | <b>3</b>              | 5,000                                    | 200                | 1.5                             | 4,200   | 120                | 1.5                             |
| <b>2040</b>   | <b>4</b>              | 4,000                                    | 240                | 2                               | 3,200   | 150                | 2                               |
| <b>2050</b>   | <b>5</b>              | 3,200                                    | 240                | 2.5                             | 2,550   | 150                | 2.5                             |
| <b>2060</b>   | <b>6</b>              | 2,650                                    | 240                | 3                               | 2,120   | 150                | 3                               |
| <b>2080</b>   | <b>8</b>              | 2,000                                    | 240                | 4                               | 1,600   | 150                | 4                               |
| <b>2100</b>   | <b>10</b>             | 1,600                                    | 240                | 5                               | 1,270   | 150                | 5                               |
| <b>2120</b>   | <b>12</b>             | 1,330                                    | 240                | 6                               | 1,060   | 150                | 6                               |

| WORK MATERIAL |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                 | HARDENED STEELS<br>SKD / SKT<br>(45~50HRC) |                    |                                 |
|---------------|-----------------------|--|--------------------|---------------------------------|--|--------------------|---------------------------------|
| Model Number  | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )                               | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| <b>2010</b>   | <b>1</b>              | 9,550  | 65                 | 0.25                            | 5,580                                      | 22                 | 0.05                            |
| <b>2020</b>   | <b>2</b>              | 4,800  | 55                 | 0.5                             | 2,790                                      | 31                 | 0.1                             |
| <b>2025</b>   | <b>2.5</b>            | 3,800  | 55                 | 0.63                            | 2,250                                      | 31                 | 0.13                            |
| <b>2030</b>   | <b>3</b>              | 3,180  | 55                 | 1.5                             | 2,120                                      | 33                 | 0.15                            |
| <b>2040</b>   | <b>4</b>              | 2,390  | 65                 | 2                               | 1,590                                      | 39                 | 0.2                             |
| <b>2050</b>   | <b>5</b>              | 1,910  | 65                 | 2.5                             | 1,270                                      | 39                 | 0.25                            |
| <b>2060</b>   | <b>6</b>              | 1,590  | 65                 | 3                               | 1,060                                      | 39                 | 0.3                             |
| <b>2080</b>   | <b>8</b>              | 1,190  | 70                 | 4                               | 800  | 39                 | 0.4                             |
| <b>2100</b>   | <b>10</b>             | 950  | 70                 | 5                               | 640  | 39                 | 0.5                             |
| <b>2120</b>   | <b>12</b>             | 800  | 70                 | 6                               | 530  | 39                 | 0.6                             |

Milling Amount for Slotting(mm)

45HRC or below

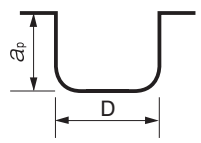
$D < \phi 3 \quad a_p = 0.25D$

$D \geq \phi 3 \quad a_p = 0.5D$

45HRC or above

$a_p = 0.05D$

D : Outside Diameter(mm)



Note:

- Recommend water soluble or oil coolant.
- Recommend oil coolant for Titanium Alloys and Heat Resistant Alloys.

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Square  
Long Neck  
Square

Radius  
Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball  
Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 6 \sim \phi 12$

# CNRS



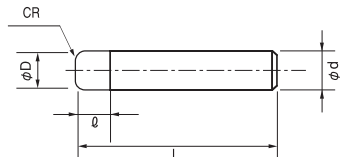
$\phi 6$        $\phi 8 \sim \phi 12$

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        | ○         | ○               |          | ●      |          |                       | ★               | ★                     |                  |                                       |

## Features

4 flute high efficient corner radius designed for Titanium Alloys and Heat Resistant Alloys.  
 UTCOAT is recommended for heat-resistant hard materials to achieve longer tool life.  
 Variable pitch, high helix and positive rake angle offer stable milling.  
 Reduced cutting force when using a helical approach or inclined angles.



Total 12 models

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Corner Radius CR | Length of Cut $\ell$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|---------------------------|------------------|----------------------|------------------|-------------------------|--------------------------|
| CNRS 4060-05-16 | 6                         | R0.5             | 16                   | 90               | 6                       | 15,000                   |
| CNRS 4060-10-16 |                           | R1               |                      | 90               | 6                       | 15,000                   |
| CNRS 4080-05-16 | 8                         | R0.5             | 16                   | 100              | 8                       | 17,800                   |
| CNRS 4080-10-16 |                           | R1               |                      | 100              | 8                       | 17,800                   |
| CNRS 4100-05-26 | 10                        | R0.5             | 26                   | 110              | 10                      | 21,800                   |
| CNRS 4100-10-26 |                           | R1               |                      | 110              | 10                      | 21,800                   |
| CNRS 4100-15-26 |                           | R1.5             |                      | 110              | 10                      | 21,800                   |
| CNRS 4100-20-26 |                           | R2               |                      | 110              | 10                      | 21,800                   |
| CNRS 4120-05-26 | 12                        | R0.5             | 26                   | 120              | 12                      | 27,700                   |
| CNRS 4120-10-26 |                           | R1               |                      | 120              | 12                      | 27,700                   |
| CNRS 4120-15-26 |                           | R1.5             |                      | 120              | 12                      | 27,700                   |
| CNRS 4120-20-26 |                           | R2               |                      | 120              | 12                      | 27,700                   |

# Milling Conditions for CNRS

## ◆Side Milling

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C       |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM           |                    |                                 |                                  | STAINLESS STEELS<br>SUS            |                    |                                 |                                  |
|---------------|-----------------------|--------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4060-05-16    | 6                     | R0.5               | 5,180                              | 1,330              | 9.6                             | 0.9                              | 4,920                              | 1,330              | 7.2                             | 0.6                              | 3,520                              | 740                | 4.8                             | 0.3                              |
| 4060-10-16    |                       | R1                 | 5,180                              | 1,330              | 9.6                             | 0.9                              | 5,180                              | 1,330              | 7.2                             | 0.6                              | 3,700                              | 740                | 4.8                             | 0.3                              |
| 4080-05-16    | 8                     | R0.5               | 3,920                              | 1,260              | 12.8                            | 1.2                              | 3,720                              | 1,260              | 9.6                             | 0.8                              | 2,660                              | 700                | 6.4                             | 0.4                              |
| 4080-10-16    |                       | R1                 | 3,920                              | 1,260              | 12.8                            | 1.2                              | 3,920                              | 1,260              | 9.6                             | 0.8                              | 2,800                              | 700                | 6.4                             | 0.4                              |
| 4100-05-26    | 10                    | R0.5               | 2,770                              | 1,225              | 16                              | 1.5                              | 2,630                              | 1,220              | 12                              | 1                                | 1,880                              | 680                | 8                               | 0.5                              |
| 4100-10-26    |                       | R1                 | 2,770                              | 1,225              | 16                              | 1.5                              | 2,770                              | 1,220              | 12                              | 1                                | 1,980                              | 680                | 8                               | 0.5                              |
| 4100-15-26    |                       | R1.5               | 2,770                              | 1,225              | 16                              | 1.5                              | 2,930                              | 1,220              | 12                              | 1                                | 2,090                              | 680                | 8                               | 0.5                              |
| 4100-20-26    |                       | R2                 | 2,770                              | 1,225              | 16                              | 1.5                              | 3,080                              | 1,220              | 12                              | 1                                | 2,200                              | 680                | 8                               | 0.5                              |
| 4120-05-26    | 12                    | R0.5               | 2,330                              | 1,170              | 19.2                            | 1.8                              | 2,210                              | 1,170              | 14.4                            | 1.2                              | 1,580                              | 650                | 9.6                             | 0.6                              |
| 4120-10-26    |                       | R1                 | 2,330                              | 1,170              | 19.2                            | 1.8                              | 2,330                              | 1,170              | 14.4                            | 1.2                              | 1,670                              | 650                | 9.6                             | 0.6                              |
| 4120-15-26    |                       | R1.5               | 2,330                              | 1,170              | 19.2                            | 1.8                              | 2,470                              | 1,170              | 14.4                            | 1.2                              | 1,760                              | 650                | 9.6                             | 0.6                              |
| 4120-20-26    |                       | R2                 | 2,330                              | 1,170              | 19.2                            | 1.8                              | 2,590                              | 1,170              | 14.4                            | 1.2                              | 1,850                              | 650                | 9.6                             | 0.6                              |

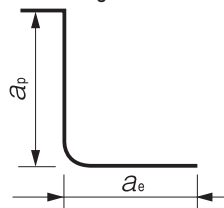
| WORK MATERIAL |                       |                    | TITANIUM / TITANIUM ALLOYS<br>Ti-6Al-4V |                    |                                 |                                  | HEAT RESISTANT ALLOYS<br>Inconel718 |                    |                                 |                                  |
|---------------|-----------------------|--------------------|---|--------------------|---------------------------------|----------------------------------|-------------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Spindle Speed (min <sup>-1</sup> )      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4060-05-16    | 6                     | R0.5               | 3,520                                   | 740                | 4.8                             | 0.3                              | 1,710                               | 300                | 4.8                             | 0.3                              |
| 4060-10-16    |                       | R1                 | 3,700                                   | 740                | 4.8                             | 0.3                              | 1,800                               | 300                | 4.8                             | 0.3                              |
| 4080-05-16    | 8                     | R0.5               | 2,660                                   | 700                | 6.4                             | 0.4                              | 1,570                               | 280                | 6.4                             | 0.4                              |
| 4080-10-16    |                       | R1                 | 2,800                                   | 700                | 6.4                             | 0.4                              | 1,650                               | 280                | 6.4                             | 0.4                              |
| 4100-05-26    | 10                    | R0.5               | 1,880                                   | 680                | 8                               | 0.5                              | 1,110                               | 250                | 8                               | 0.5                              |
| 4100-10-26    |                       | R1                 | 1,980                                   | 680                | 8                               | 0.5                              | 1,170                               | 250                | 8                               | 0.5                              |
| 4100-15-26    |                       | R1.5               | 2,090                                   | 680                | 8                               | 0.5                              | 1,240                               | 250                | 8                               | 0.5                              |
| 4100-20-26    |                       | R2                 | 2,200                                   | 680                | 8                               | 0.5                              | 1,300                               | 250                | 8                               | 0.5                              |
| 4120-05-26    | 12                    | R0.5               | 1,580                                   | 650                | 9.6                             | 0.6                              | 940                                 | 220                | 9.6                             | 0.6                              |
| 4120-10-26    |                       | R1                 | 1,670                                   | 650                | 9.6                             | 0.6                              | 990                                 | 220                | 9.6                             | 0.6                              |
| 4120-15-26    |                       | R1.5               | 1,760                                   | 650                | 9.6                             | 0.6                              | 1,050                               | 220                | 9.6                             | 0.6                              |
| 4120-20-26    |                       | R2                 | 1,850                                   | 650                | 9.6                             | 0.6                              | 1,100                               | 220                | 9.6                             | 0.6                              |

Please adjust milling parameters referring following table.

D : φ 6 ~ φ 12

| Overhang Length | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
|-----------------|------------------------------------|--------------------|---------------------------------|----------------------------------|
| ~D×4            | ×1                                 | ×1                 | ×1                              | ×1                               |
| ~D×5            | ×0.7                               | ×0.7               | ×0.7                            | ×0.8                             |
| ~D×6            | ×0.5                               | ×0.5               | ×0.6                            | ×0.7                             |

Side Milling



4 Flutes

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for CNRS

### ◆Slotting

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C       |                    |                                 | ALLOY STEELS<br>SK / SCM           |                    |                                 | STAINLESS STEELS<br>SUS            |                    |                                 |
|---------------|-----------------------|--------------------|------------------------------------|--------------------|---------------------------------|------------------------------------|--------------------|---------------------------------|------------------------------------|--------------------|---------------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 4060-05-16    | 6                     | R0.5               | 2,035                              | 250                | 6                               | 1,930                              | 360                | 3                               | 1,760                              | 330                | 1.5                             |
| 4060-10-16    |                       | R1                 | 2,035                              | 250                | 6                               | 2,040                              | 360                | 3                               | 1,850                              | 330                | 1.5                             |
| 4080-05-16    | 8                     | R0.5               | 1,550                              | 210                | 8                               | 1,470                              | 300                | 4                               | 1,340                              | 270                | 2                               |
| 4080-10-16    |                       | R1                 | 1,550                              | 210                | 8                               | 1,550                              | 300                | 4                               | 1,410                              | 270                | 2                               |
| 4100-05-26    | 10                    | R0.5               | 1,260                              | 210                | 10                              | 1,200                              | 300                | 5                               | 1,090                              | 270                | 2.5                             |
| 4100-10-26    |                       | R1                 | 1,260                              | 210                | 10                              | 1,260                              | 300                | 5                               | 1,150                              | 270                | 2.5                             |
| 4100-15-26    |                       | R1.5               | 1,260                              | 210                | 10                              | 1,330                              | 300                | 5                               | 1,210                              | 270                | 2.5                             |
| 4100-20-26    |                       | R2                 | 1,260                              | 210                | 10                              | 1,400                              | 300                | 5                               | 1,270                              | 270                | 2.5                             |
| 4120-05-26    | 12                    | R0.5               | 1,020                              | 200                | 12                              | 970                                | 290                | 6                               | 880                                | 260                | 3                               |
| 4120-10-26    |                       | R1                 | 1,020                              | 200                | 12                              | 1,020                              | 290                | 6                               | 930                                | 260                | 3                               |
| 4120-15-26    |                       | R1.5               | 1,020                              | 200                | 12                              | 1,080                              | 290                | 6                               | 980                                | 260                | 3                               |
| 4120-20-26    |                       | R2                 | 1,020                              | 200                | 12                              | 1,140                              | 290                | 6                               | 1,030                              | 260                | 3                               |

| WORK MATERIAL |                       |                    | TITANIUM / TITANIUM ALLOYS<br>Ti-6Al-4V |                    |                                 | HEAT RESISTANT ALLOYS<br>Inconel718 |                    |                                 |
|---------------|-----------------------|--------------------|---|--------------------|---------------------------------|-------------------------------------|--------------------|---------------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Spindle Speed (min <sup>-1</sup> )      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 4060-05-16    | 6                     | R0.5               | 1,600                                   | 300                | 0.6                             | 810                                 | 100                | 0.6                             |
| 4060-10-16    |                       | R1                 | 1,680                                   | 300                | 0.6                             | 850                                 | 100                | 0.6                             |
| 4080-05-16    | 8                     | R0.5               | 1,220                                   | 250                | 0.8                             | 620                                 | 90                 | 0.8                             |
| 4080-10-16    |                       | R1                 | 1,280                                   | 250                | 0.8                             | 650                                 | 90                 | 0.8                             |
| 4100-05-26    | 10                    | R0.5               | 990                                     | 250                | 1                               | 460                                 | 80                 | 1                               |
| 4100-10-26    |                       | R1                 | 1,040                                   | 250                | 1                               | 490                                 | 80                 | 1                               |
| 4100-15-26    |                       | R1.5               | 1,100                                   | 250                | 1                               | 520                                 | 80                 | 1                               |
| 4100-20-26    |                       | R2                 | 1,160                                   | 250                | 1                               | 540                                 | 80                 | 1                               |
| 4120-05-26    | 12                    | R0.5               | 800                                     | 240                | 1.2                             | 380                                 | 70                 | 1.2                             |
| 4120-10-26    |                       | R1                 | 840                                     | 240                | 1.2                             | 410                                 | 70                 | 1.2                             |
| 4120-15-26    |                       | R1.5               | 890                                     | 240                | 1.2                             | 430                                 | 70                 | 1.2                             |
| 4120-20-26    |                       | R2                 | 940                                     | 240                | 1.2                             | 450                                 | 70                 | 1.2                             |

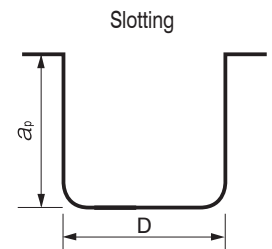
Please adjust milling parameters referring following table.

D :  $\phi 6 \sim \phi 12$

| Overhang Length | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
|-----------------|------------------------------------|--------------------|---------------------------------|----------------------------------|
| ~D×4            | ×1                                 | ×1                 | ×1                              | ×1                               |
| ~D×5            | ×0.7                               | ×0.7               | ×0.7                            | ×0.8                             |
| ~D×6            | ×0.5                               | ×0.5               | ×0.6                            | ×0.7                             |

Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Recommend water soluble or oil coolant.



D : Outside Diameter (mm)



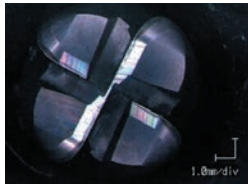
**Pocket Milling Example: Milling with CNRS  $\phi 10 \times CR2$**

**Ti6Al-4V (30HRC)**



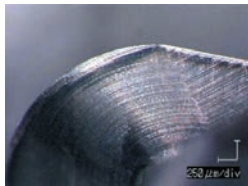
**Stable milling on hard-to-cut materials**

| Spindle Speed                                 | Feed Rate                          | $a_p$  | $a_e$ | Overhang Length | Cycle Time | Coolant                         | Pocket Size     |
|---|------------------------------------|--------|-------|-----------------|------------|---------------------------------|-----------------|
| 1,820 min <sup>-1</sup><br>$V_c=$<br>57 m/min | 700 mm/min<br>$f_z=$<br>0.096 mm/t | 0.5 mm | 5 mm  | 45 mm (4.5D)    | 30 min     | Water Soluble (Through Spindle) | 70 × 44 × 13 mm |



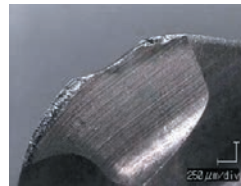
**CNRS**

Continuous cutting is possible after 60 min milling.



**Competitor's Tool**

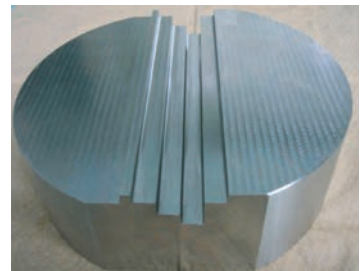
Corner radius is broken after 30min (one pocket) milling.



**Slotting Example: Milling with CNRS  $\phi 8 \times CR1$**

**Inconel718 (40HRC)**

| Milling Process | Roughing                                     |  | Finishing                        |
|-----------------|--|--|----------------------------------|
|                 | Slotting                                     | Side Milling                                   |                                  |
| Spindle Speed   | 576 min <sup>-1</sup><br>( $V_c=14.5$ m/min) | 1,650 min <sup>-1</sup><br>( $V_c=41.5$ m/min) |                                  |
| Feed Rate       | 72 mm/min<br>( $f_z=0.03$ mm/t)              | 280 mm/min<br>( $f_z=0.04$ mm/t)               | 200 mm/min<br>( $f_z=0.03$ mm/t) |
| $a_p$           | 0.8 mm                                       | 6.4 mm   | 0.1 mm                           |
| $a_e$           | —  | 0.4 mm   | 0.1 mm                           |
| Overhang Length | 30 mm (3.75D)                                |  |                                  |
| Coolant         | Water Soluble (Nozzle)                       |  |                                  |
| Cycle Time      | 105 min                                      |  | 10 min                           |



**Reduces burrs in step milling process.  
Offers better surface finish with unique cutting edge.**

4 Flutes

$\phi 3$ mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



Size  $\phi 1 \sim \phi 12$

# CXERS



$\phi 1 \sim \phi 3$   $\phi 4 \sim \phi 6$   $\phi 8 \sim \phi 12$

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        |           |                 |          | ●      |          |                       | ○               | ○                     |                  |                                       |

## Features

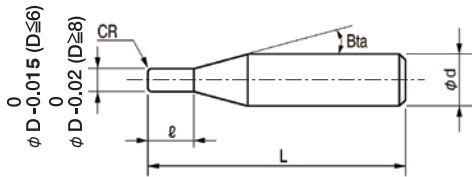
Variable Division & Variable Helix design minimizes vibration and chattering.

Selected carbide material with high toughness & high chip resistance.

Excellent wear-resistance for the wide range of milling applications, from highly efficient milling to finishing.

Low friction coating resulting in excellent chip evacuation and resistance to wear.

Decreasing cutting resistance and offering stable milling by the original corner R design.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 56 models

Unit (mm)

| Model Number       | Outside Diameter $\phi D$ | Corner Radius CR | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------------|---------------------------|------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| CXERS 4010-01-025  | 1                         | RO.1             | 2.5                  | 16°                   | 50               | 4                       | 6,850                    |
| CXERS 4010-02-025  |                           | RO.2             |                      |                       | 50               | 4                       | 6,850                    |
| CXERS 4010-03-025  |                           | RO.3             |                      |                       | 50               | 4                       | 7,300                    |
| CXERS 4015-01-0375 | 1.5                       | RO.1             | 3.75                 | 16°                   | 50               | 4                       | 6,850                    |
| CXERS 4015-02-0375 |                           | RO.2             |                      |                       | 50               | 4                       | 6,850                    |
| CXERS 4015-03-0375 |                           | RO.3             |                      |                       | 50               | 4                       | 7,300                    |
| CXERS 4020-01-050  | 2                         | RO.1             | 5                    | 16°                   | 50               | 4                       | 6,410                    |
| CXERS 4020-02-050  |                           | RO.2             |                      |                       | 50               | 4                       | 6,410                    |
| CXERS 4020-03-050  |                           | RO.3             |                      |                       | 50               | 4                       | 6,850                    |
| CXERS 4020-05-050  |                           | RO.5             |                      |                       | 50               | 4                       | 6,850                    |
| CXERS 4025-03-0625 | 2.5                       | RO.3             | 6.25                 | 16°                   | 50               | 4                       | 6,850                    |
| CXERS 4025-05-0625 |                           | RO.5             |                      |                       | 50               | 4                       | 6,850                    |
| CXERS 4030-02-075  | 3                         | RO.2             | 7.5                  | 16°                   | 60               | 6                       | 7,350                    |
| CXERS 4030-03-075  |                           | RO.3             |                      |                       | 60               | 6                       | 7,850                    |
| CXERS 4030-05-075  |                           | RO.5             |                      |                       | 60               | 6                       | 7,850                    |

Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Length of Cut $l$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-------------------|---------------------------|------------------|-------------------|---------------------------|------------------|-------------------------|--------------------------|
| CXERS 4040-02-100 | 4                         | RO.2             | 10                | 16°                       | 60               | 6                       | 7,720                    |
| CXERS 4040-03-100 |                           | RO.3             |                   |                           | 60               | 6                       | 8,250                    |
| CXERS 4040-04-100 |                           | RO.4             |                   |                           | 60               | 6                       | 8,250                    |
| CXERS 4040-05-100 |                           | RO.5             |                   |                           | 60               | 6                       | 8,250                    |
| CXERS 4040-10-100 |                           | R1               |                   |                           | 60               | 6                       | 8,250                    |
| CXERS 4050-02-125 | 5                         | RO.2             | 12.5              | 16°                       | 60               | 6                       | 8,300                    |
| CXERS 4050-03-125 |                           | RO.3             |                   |                           | 60               | 6                       | 8,850                    |
| CXERS 4050-04-125 |                           | RO.4             |                   |                           | 60               | 6                       | 8,850                    |
| CXERS 4050-05-125 |                           | RO.5             |                   |                           | 60               | 6                       | 8,850                    |
| CXERS 4050-10-125 |                           | R1               |                   |                           | 60               | 6                       | 8,850                    |
| CXERS 4060-02-150 | 6                         | RO.2             | 15                | —                         | 60               | 6                       | 8,640                    |
| CXERS 4060-03-150 |                           | RO.3             |                   |                           | 60               | 6                       | 8,640                    |
| CXERS 4060-04-150 |                           | RO.4             |                   |                           | 60               | 6                       | 9,500                    |
| CXERS 4060-05-150 |                           | RO.5             |                   |                           | 60               | 6                       | 9,500                    |
| CXERS 4060-10-150 |                           | R1               |                   |                           | 60               | 6                       | 9,500                    |
| CXERS 4060-12-150 | R1.2                      | 60               | 6                 | 9,500                     |                  |                         |                          |
| CXERS 4080-02-200 | 8                         | RO.2             | 20                | —                         | 70               | 8                       | 11,000                   |
| CXERS 4080-03-200 |                           | RO.3             |                   |                           | 70               | 8                       | 11,000                   |
| CXERS 4080-04-200 |                           | RO.4             |                   |                           | 70               | 8                       | 11,800                   |
| CXERS 4080-05-200 |                           | RO.5             |                   |                           | 70               | 8                       | 11,800                   |
| CXERS 4080-10-200 |                           | R1               |                   |                           | 70               | 8                       | 11,800                   |
| CXERS 4080-12-200 |                           | R1.2             |                   |                           | 70               | 8                       | 11,800                   |
| CXERS 4080-15-200 |                           | R1.5             |                   |                           | 70               | 8                       | 11,800                   |
| CXERS 4080-20-200 |                           | R2               |                   |                           | 70               | 8                       | 11,800                   |
| CXERS 4100-02-250 | 10                        | RO.2             | 25                | —                         | 80               | 10                      | 13,100                   |
| CXERS 4100-03-250 |                           | RO.3             |                   |                           | 80               | 10                      | 13,100                   |
| CXERS 4100-04-250 |                           | RO.4             |                   |                           | 80               | 10                      | 14,000                   |
| CXERS 4100-05-250 |                           | RO.5             |                   |                           | 80               | 10                      | 14,000                   |
| CXERS 4100-10-250 |                           | R1               |                   |                           | 80               | 10                      | 14,000                   |
| CXERS 4100-12-250 |                           | R1.2             |                   |                           | 80               | 10                      | 14,000                   |
| CXERS 4100-15-250 |                           | R1.5             |                   |                           | 80               | 10                      | 14,000                   |
| CXERS 4100-20-250 |                           | R2               |                   |                           | 80               | 10                      | 14,000                   |
| CXERS 4120-02-300 | 12                        | RO.2             | 30                | —                         | 100              | 12                      | 18,750                   |
| CXERS 4120-03-300 |                           | RO.3             |                   |                           | 100              | 12                      | 20,000                   |
| CXERS 4120-04-300 |                           | RO.4             |                   |                           | 100              | 12                      | 20,000                   |
| CXERS 4120-05-300 |                           | RO.5             |                   |                           | 100              | 12                      | 20,000                   |
| CXERS 4120-10-300 |                           | R1               |                   |                           | 100              | 12                      | 20,000                   |
| CXERS 4120-12-300 |                           | R1.2             |                   |                           | 100              | 12                      | 20,000                   |
| CXERS 4120-15-300 |                           | R1.5             |                   |                           | 100              | 12                      | 20,000                   |
| CXERS 4120-20-300 |                           | R2               |                   |                           | 100              | 12                      | 20,000                   |
| CXERS 4120-30-300 | R3                        | 100              | 12                | 20,000                    |                  |                         |                          |

4 Flutes

ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
RadiusTaper Neck  
Radius

Ball

Ball / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

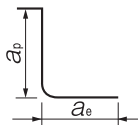
Technical Data

## Milling Conditions for CXERS

### ◆Side Milling

| WORK MATERIAL       |                       | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB)                            |                    |                        |                         | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB)                             |                    |                        |                         | STAINLESS STEELS<br>SUS304<br>※Use water soluble or oil coolant. |                    |                        |                         |
|---------------------|-----------------------|--|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|
| Model Number        | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                               | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 4010                | 1                     | 21,600   | 490                | 2.5                    | 0.1                     | 21,600   | 360                | 2.5                    | 0.1                     | 17,400   | 250                | 2.5                    | 0.1                     |
| 4015                | 1.5                   | 16,200   | 610                | 3.75                   | 0.15                    | 16,200   | 450                | 3.75                   | 0.15                    | 15,960   | 270                | 3.75                   | 0.15                    |
| 4020                | 2                     | 13,200   | 740                | 5                      | 0.2                     | 13,200   | 550                | 5                      | 0.2                     | 14,640   | 280                | 5                      | 0.2                     |
| 4025                | 2.5                   | 11,400   | 840                | 6.25                   | 0.25                    | 11,400   | 640                | 6.25                   | 0.25                    | 13,200   | 390                | 6.25                   | 0.25                    |
| 4030                | 3                     | 10,200   | 960                | 7.5                    | 0.3                     | 10,200   | 720                | 7.5                    | 0.3                     | 12,000   | 510                | 7.5                    | 0.3                     |
| 4040                | 4                     | 8,640  | 1,350              | 10                     | 0.8                     | 8,040  | 1,000              | 10                     | 0.8                     | 9,000  | 730                | 10                     | 0.4                     |
| 4050                | 5                     | 7,200  | 1,500              | 12.5                   | 1                       | 6,480  | 1,100              | 12.5                   | 1                       | 6,480  | 810                | 12.5                   | 0.5                     |
| 4060                | 6                     | 6,000  | 1,600              | 15                     | 1.2                     | 5,400  | 1,200              | 15                     | 1.2                     | 5,400  | 810                | 15                     | 0.6                     |
| 4080                | 8                     | 3,600  | 1,300              | 20                     | 1.6                     | 3,480  | 1,050              | 20                     | 1.6                     | 3,480  | 720                | 20                     | 0.8                     |
| 4010                | 10                    | 1,920  | 1,000              | 25                     | 2                       | 1,800  | 900                | 25                     | 2                       | 1,800  | 580                | 25                     | 1                       |
| 4012                | 12                    | 1,440  | 800                | 30                     | 2.4                     | 1,440  | 750                | 30                     | 2.4                     | 1,440  | 540                | 30                     | 1.2                     |
| Milling Amount (mm) |                       | $a_p$ : All Flute<br>$a_e$ : 0.1D ( $\phi D < 4$ )<br>$a_e$ : 0.2D ( $\phi D \geq 4$ ) |                    |                        |                         | $a_p$ : All Flute<br>$a_e$ : 0.1D ( $\phi D < 4$ )<br>$a_e$ : 0.2D ( $\phi D \geq 4$ ) |                    |                        |                         | $a_p$ : All Flute<br>$a_e$ : 0.1D                                |                    |                        |                         |

### Side Milling



## Milling Conditions for CXERS

| WORK MATERIAL       |                       | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC)  |                    |                        |                         | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                        |                         |
|---------------------|-----------------------|--|--------------------|------------------------|-------------------------|---|--------------------|------------------------|-------------------------|
| Model Number        | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 4010                | 1                     | 15,480   | 250                | 2.5                    | 0.1                     | 12,900  | 180                | 2.5                    | 0.05                    |
| 4015                | 1.5                   | 12,600   | 310                | 3.75                   | 0.15                    | 9,300   | 280                | 3.75                   | 0.075                   |
| 4020                | 2                     | 11,220   | 360                | 5                      | 0.2                     | 7,600   | 390                | 5                      | 0.1                     |
| 4025                | 2.5                   | 9,960  | 430                | 6.25                   | 0.25                    | 6,500   | 510                | 6.25                   | 0.125                   |
| 4030                | 3                     | 8,880  | 500                | 7.5                    | 0.3                     | 5,900   | 500                | 7.5                    | 0.3                     |
| 4040                | 4                     | 7,080  | 650                | 10                     | 0.8                     | 4,700   | 520                | 10                     | 0.4                     |
| 4050                | 5                     | 5,760  | 680                | 12.5                   | 1                       | 3,850   | 530                | 12.5                   | 0.5                     |
| 4060                | 6                     | 4,800  | 680                | 15                     | 1.2                     | 3,200   | 540                | 15                     | 0.6                     |
| 4080                | 8                     | 3,000  | 600                | 20                     | 1.6                     | 2,000   | 500                | 20                     | 0.8                     |
| 4010                | 10                    | 1,800  | 430                | 25                     | 2                       | 1,200   | 450                | 25                     | 1                       |
| 4012                | 12                    | 1,200  | 320                | 30                     | 2.4                     | 960   | 420                | 30                     | 1.2                     |
| Milling Amount (mm) |                       | $a_p$ : All Flute<br>$a_e$ : 0.1D ( $\phi D < 4$ )<br>$a_e$ : 0.2D ( $\phi D \geq 4$ ) |                    |                        |                         | $a_p$ : All Flute<br>$a_e$ : 0.1D                   |                    |                        |                         |

4 Flutes

ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

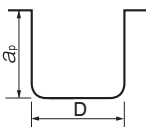
Technical Data

## Milling Conditions for CXERS

### ◆Slotting

| WORK MATERIAL       |                       | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                                 | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                                 | STAINLESS STEELS<br>SUS304<br>※Use water soluble or oil coolant. |                    |                                 |
|---------------------|-----------------------|---|--------------------|---------------------------------|--|--------------------|---------------------------------|--|--------------------|---------------------------------|
| Model Number        | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                               | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) |
| 4010                | 1                     | 21,600  | 160                | 1                               | 21,600   | 160                | 1                               | 17,400   | 170                | 0.5                             |
| 4015                | 1.5                   | 16,200  | 250                | 1.5                             | 16,200   | 220                | 1.5                             | 15,960   | 190                | 0.75                            |
| 4020                | 2                     | 13,200  | 360                | 2                               | 13,200   | 250                | 2                               | 14,640   | 200                | 1                               |
| 4025                | 2.5                   | 11,400  | 430                | 2.5                             | 11,400   | 280                | 2.5                             | 13,200   | 240                | 1.25                            |
| 4030                | 3                     | 10,200  | 480                | 3                               | 10,200   | 320                | 3                               | 12,000   | 280                | 1.5                             |
| 4040                | 4                     | 8,640   | 650                | 4                               | 8,040  | 450                | 4                               | 9,000  | 400                | 2                               |
| 4050                | 5                     | 7,200   | 700                | 5                               | 6,480  | 500                | 5                               | 6,480  | 460                | 2.5                             |
| 4060                | 6                     | 6,000   | 700                | 6                               | 5,400  | 500                | 6                               | 5,400  | 460                | 3                               |
| 4080                | 8                     | 3,600   | 500                | 8                               | 3,480  | 360                | 8                               | 3,480  | 340                | 4                               |
| 4100                | 10                    | 1,920   | 380                | 10                              | 1,800  | 270                | 10                              | 1,800  | 220                | 5                               |
| 4120                | 12                    | 1,440   | 300                | 12                              | 1,440  | 210                | 12                              | 1,440  | 180                | 6                               |
| Milling Amount (mm) |                       | a <sub>p</sub> :1D  |                    |                                 | a <sub>p</sub> :1D   |                    |                                 | a <sub>p</sub> :0.5D   |                    |                                 |

### Slotting



D : Outside Diameter (mm)

### Note:

- Decrease both spindle speed and feed rate proportionally in case of chattering.
- These milling parameters are calculated based on the shortest overhang length. Longer overhangs may require an adjustment to the milling parameters.
- Reduce the milling amount and feed rate in accordance with required milling precision.
- Every coolant offers stable milling.
- Recommend water soluble or oil coolant for Stainless Steels and Copper.

## Milling Conditions for CXERS

| WORK MATERIAL       |                       | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                        | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                        |
|---------------------|-----------------------|---|--------------------|------------------------|---|--------------------|------------------------|
| Model Number        | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) |
| 4010                | 1                     | 15,480  | 100                | 1                      | 12,900  | 50                 | 0.3                    |
| 4015                | 1.5                   | 12,600  | 140                | 1.5                    | 10,500  | 100                | 0.45                   |
| 4020                | 2                     | 11,220  | 170                | 2                      | 9,350   | 150                | 0.6                    |
| 4025                | 2.5                   | 9,960   | 210                | 2.5                    | 8,300   | 240                | 0.75                   |
| 4030                | 3                     | 8,880   | 250                | 3                      | 7,400   | 360                | 1.5                    |
| 4040                | 4                     | 7,080   | 390                | 4                      | 5,900   | 380                | 2                      |
| 4050                | 5                     | 5,760   | 440                | 5                      | 4,800   | 410                | 2.5                    |
| 4060                | 6                     | 4,800   | 440                | 6                      | 4,000   | 440                | 3                      |
| 4080                | 8                     | 3,000   | 340                | 8                      | 2,500   | 340                | 4                      |
| 4100                | 10                    | 1,800   | 220                | 10                     | 1,500   | 240                | 5                      |
| 4120                | 12                    | 1,200   | 180                | 12                     | 1,200   | 220                | 6                      |
| Milling Amount (mm) |                       | $a_p : 1D$                                    |                    |                        | $a_p : 0.5D$  |                    |                        |

4 Flutes

ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 3 \sim \phi 12$

**CXRS**



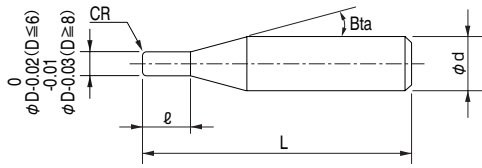
$\phi 3 \sim \phi 6$     $\phi 8 \sim \phi 12$

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        | ○         | ○               |          | ●      |          |                       | ○               | ○                     |                  |                                       |

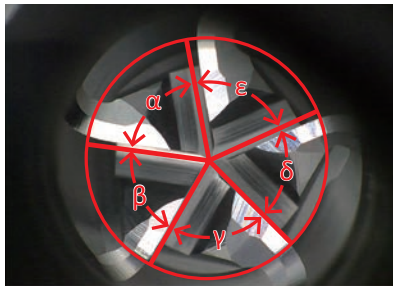
**Features**

Recommended on a wide range of materials – Carbon Steels and Hardened steels up to 55 HRC.  
Variable pitch & helix design and positive rake angle offer highly efficient side milling.  
Seamless corner radius design greatly reduces cutting force.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

**Variable Pitch**

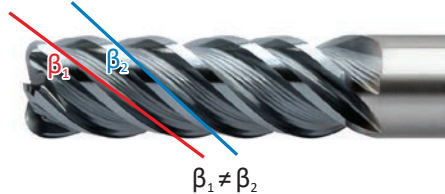


$\alpha \neq \beta \neq \gamma \neq \delta \neq \epsilon$

**Corner Radius Design**



**Variable Helix**



$\beta_1 \neq \beta_2$

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



Total 30 models

Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-------------------|---------------------------|------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| CXRS 5030-05-0600 | 3                         | R0.5             | 6                    | 16°                   | 50               | 6                       | 8,250                    |
| CXRS 5030-05-0900 |                           |                  | 9                    |                       | 50               |                         |                          |
| CXRS 5040-05-0800 | 4                         | R0.5             | 8                    | 16°                   | 60               | 6                       | 8,900                    |
| CXRS 5040-05-1200 |                           |                  | 12                   |                       | 60               |                         |                          |
| CXRS 5040-10-0800 |                           | R1               | 8                    |                       | 60               |                         |                          |
| CXRS 5040-10-1200 |                           |                  | 12                   |                       | 60               |                         |                          |
| CXRS 5060-05-1200 | 6                         | R0.5             | 12                   | —                     | 70               | 6                       | 9,600                    |
| CXRS 5060-05-1800 |                           |                  | 18                   |                       | 70               |                         |                          |
| CXRS 5060-10-1200 |                           | R1               | 12                   |                       | 70               |                         |                          |
| CXRS 5060-10-1800 |                           |                  | 18                   |                       | 70               |                         |                          |
| CXRS 5080-05-1600 | 8                         | R0.5             | 16                   | —                     | 70               | 8                       | 13,800                   |
| CXRS 5080-05-2400 |                           |                  | 24                   |                       | 70               |                         |                          |
| CXRS 5080-10-1600 |                           | R1               | 16                   |                       | 70               |                         |                          |
| CXRS 5080-10-2400 |                           |                  | 24                   |                       | 70               |                         |                          |
| CXRS 5100-05-2000 | 10                        | R0.5             | 20                   | —                     | 80               | 10                      | 16,800                   |
| CXRS 5100-05-3000 |                           |                  | 30                   |                       | 80               |                         |                          |
| CXRS 5100-10-2000 |                           | R1               | 20                   |                       | 80               |                         |                          |
| CXRS 5100-10-3000 |                           |                  | 30                   |                       | 80               |                         |                          |
| CXRS 5100-15-2000 |                           | R1.5             | 20                   |                       | 80               |                         |                          |
| CXRS 5100-15-3000 |                           |                  | 30                   |                       | 80               |                         |                          |
| CXRS 5100-20-2000 |                           | R2               | 20                   |                       | 80               |                         |                          |
| CXRS 5100-20-3000 |                           |                  | 30                   |                       | 80               |                         |                          |
| CXRS 5120-05-2400 | 12                        | R0.5             | 24                   | —                     | 80               | 12                      | 22,000                   |
| CXRS 5120-05-3600 |                           |                  | 36                   |                       | 100              |                         |                          |
| CXRS 5120-10-2400 |                           | R1               | 24                   |                       | 80               |                         |                          |
| CXRS 5120-10-3600 |                           |                  | 36                   |                       | 100              |                         |                          |
| CXRS 5120-15-2400 |                           | R1.5             | 24                   |                       | 80               |                         |                          |
| CXRS 5120-15-3600 |                           |                  | 36                   |                       | 100              |                         |                          |
| CXRS 5120-20-2400 |                           | R2               | 24                   |                       | 80               |                         |                          |
| CXRS 5120-20-3600 |                           |                  | 36                   |                       | 100              |                         |                          |

5 Flutes

$\phi 3$ mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Square  
Long Neck Square

Radius  
Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Ball  
Long Neck Ball  
Taper Neck Ball

Taper  
Taper

Barrel

Spiral V Cutter

Drill

Technical Data

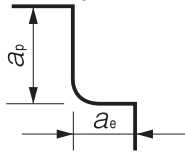
Milling Conditions for CXRS

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S50C<br>Annealed Materials<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM<br>Annealed Materials<br>(225~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                                 |                                  |
|---------------|-----------------------|--------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                             | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 5030          | 3                     | 6                  | 20,000   | 10,000             | 6                               | 0.3                              | 20,000  | 10,000             | 6                               | 0.3                              | 20,000  | 10,000             | 6                               | 0.09                             | 20,000  | 12,000             | 6                               | 0.06                             |
|               |                       | 9                  | 20,000   | 6,000              | 8                               | 0.24                             | 20,000  | 6,000              | 8                               | 0.24                             | 20,000  | 6,400              | 8                               | 0.09                             | 20,000  | 12,000             | 8                               | 0.05                             |
| 5040          | 4                     | 8                  | 18,200   | 9,100              | 8                               | 0.4                              | 18,200  | 9,100              | 8                               | 0.4                              | 19,800  | 9,900              | 8                               | 0.12                             | 15,000  | 11,500             | 8                               | 0.08                             |
|               |                       | 12                 | 18,200   | 5,460              | 10.8                            | 0.32                             | 18,200  | 5,460              | 10.8                            | 0.32                             | 15,900  | 4,770              | 10.8                            | 0.12                             | 15,000  | 11,500             | 10.8                            | 0.05                             |
| 5060          | 6                     | 12                 | 12,200   | 6,100              | 12                              | 0.6                              | 12,200  | 6,100              | 12                              | 0.6                              | 13,200  | 6,500              | 12                              | 0.21                             | 10,000  | 7,600              | 12                              | 0.15                             |
|               |                       | 18                 | 12,200   | 5,100              | 16                              | 0.48                             | 12,200  | 5,100              | 16                              | 0.48                             | 12,000  | 5,000              | 16                              | 0.18                             | 10,000  | 7,600              | 16                              | 0.1                              |
| 5080          | 8                     | 16                 | 9,100  | 4,550              | 16                              | 0.8                              | 9,100   | 4,550              | 16                              | 0.8                              | 9,900   | 4,950              | 16                              | 0.4                              | 7,600   | 5,600              | 16                              | 0.2                              |
|               |                       | 24                 | 9,100  | 4,550              | 21                              | 0.64                             | 9,100   | 4,550              | 21                              | 0.64                             | 9,000   | 4,500              | 21                              | 0.32                             | 7,600   | 5,600              | 21                              | 0.15                             |
| 5100          | 10                    | 20                 | 7,300  | 3,650              | 20                              | 1                                | 7,300   | 3,650              | 20                              | 1                                | 8,000   | 4,600              | 20                              | 0.5                              | 6,000   | 4,500              | 20                              | 0.25                             |
|               |                       | 30                 | 7,300  | 3,650              | 27                              | 0.8                              | 7,300   | 3,650              | 27                              | 0.8                              | 7,300   | 3,650              | 27                              | 0.4                              | 6,000   | 4,500              | 27                              | 0.22                             |
| 5120          | 12                    | 24                 | 6,100  | 3,050              | 24                              | 1.2                              | 6,100   | 3,050              | 24                              | 1.2                              | 6,600   | 3,960              | 24                              | 0.6                              | 5,000   | 3,800              | 24                              | 0.3                              |
|               |                       | 36                 | 6,100  | 3,050              | 32                              | 0.96                             | 6,100   | 3,050              | 32                              | 0.96                             | 6,100   | 3,050              | 32                              | 0.48                             | 5,000   | 3,800              | 32                              | 0.25                             |

Note:

- Please be sure to use water soluble coolant.
- These milling parameters are for reference only.
- For best result, fine parameter adjustments may be required, depending on the milling shape / application / machine used and so on.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- WARNING: Because of high material removal rate, you must pay attention to your chip and coolant management.

Side Milling

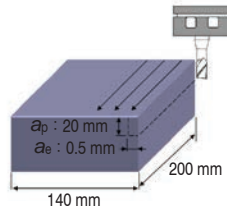


- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

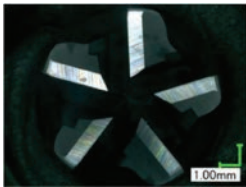
## 5 Flutes v.s. 4 Flutes Comparison of Cutting Chips

STAVAX (53HRC)

Size : 140 x 200 mm  
 Coolant : Oil Mist  
 Milling Method : Side Milling  
 Spindle Speed : 4,000 min<sup>-1</sup>  
 Feed Rate : 2,500 mm/min  
 $a_p$  : 20 mm  
 $a_e$  : 0.5 mm



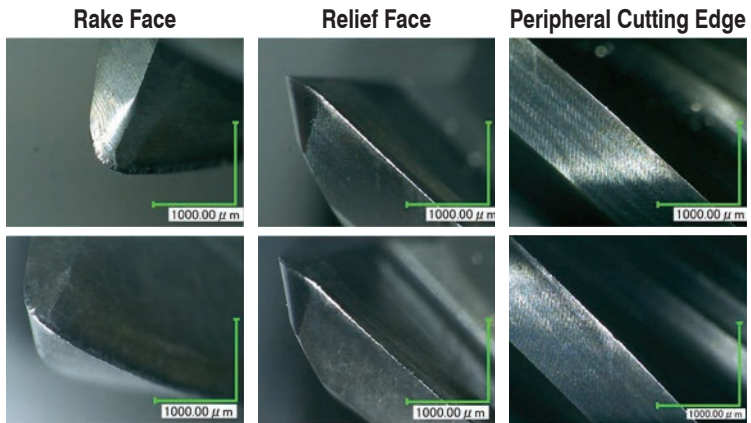
### ◆ 5 Flute Radius $\phi 10 \times CR0.5 \times L20$



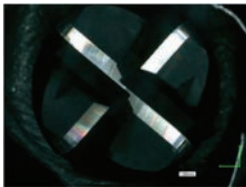
After 40 min



After 80 min



### ◆ 4 Flute Radius $\phi 10 \times CR1 \times L26$



After 40 min



### ◆ Comparison of Cutting Chips

**5 Flutes**  
 Uniform cutting chips



**4 Flutes**  
 Irregular size cutting chips



**5 flutes, variable pitch and variable helix design protect the tool from chattering and chipping under high-speed condition.**

5 Flutes

$\phi 3$ mm Shank  
 V Series

UDC-PCD  
 Series

CBN  
 Series

Square

Long Neck  
 Square

Radius

Long Neck  
 Radius

Taper Neck  
 Radius

Ball / Long  
 Shank Ball

Long Neck  
 Ball

Taper Neck  
 Ball

Taper

Barrel

Spiral  
 V Cutter

Drill

Technical Data



Size  $\phi 3 \sim \phi 12$

# HMERS



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 | ○                                | ●               | ●      | ●      | ●      |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |

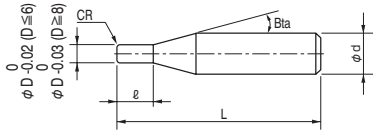
## Features

**Radius End Mills for Hard Materials.**

**4 and 6 Flutes have been applied to suitable sizes to offer outstandingly long tool life.**

**HARDMAX coat enables highly efficient milling for 65HRC High Speed Steels.**

**Various Corner Radius sizes available.**



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

A lineup of 4 flutes and 6 flutes that considers high efficiency and chip evacuation performance according to the tool diameter.

$\phi 3 \sim \phi 5$  4 flutes



$\phi 6 \sim \phi 12$  6 flutes



Total 37 models

Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Length of Cut $\ell$ | Shank Taper Angle $B\alpha$ | Overall Length L | Shank Diameter $\phi d$ | Number of Flutes | Suggested Retail Price ¥ |
|-------------------|---------------------------|------------------|----------------------|-----------------------------|------------------|-------------------------|------------------|--------------------------|
| HMERS 4030-01-075 | 3                         | RO.1             | 7.5                  | 16°                         | 60               | 6                       | 4                | 15,000                   |
| HMERS 4030-02-075 |                           | RO.2             |                      |                             | 60               | 6                       |                  | 15,000                   |
| HMERS 4030-03-075 |                           | RO.3             |                      |                             | 60               | 6                       |                  | 15,000                   |
| HMERS 4030-05-075 |                           | RO.5             |                      |                             | 60               | 6                       |                  | 15,000                   |
| HMERS 4040-01-100 | 4                         | RO.1             | 10                   | 16°                         | 60               | 6                       | 4                | 16,200                   |
| HMERS 4040-02-100 |                           | RO.2             |                      |                             | 60               | 6                       |                  | 16,200                   |
| HMERS 4040-03-100 |                           | RO.3             |                      |                             | 60               | 6                       |                  | 16,200                   |
| HMERS 4040-05-100 |                           | RO.5             |                      |                             | 60               | 6                       |                  | 16,200                   |
| HMERS 4040-10-100 |                           | R1               |                      |                             | 60               | 6                       |                  | 16,200                   |
| HMERS 4050-01-125 | 5                         | RO.1             | 12.5                 | 16°                         | 60               | 6                       | 4                | 17,400                   |
| HMERS 4050-02-125 |                           | RO.2             |                      |                             | 60               | 6                       |                  | 17,400                   |
| HMERS 4050-03-125 |                           | RO.3             |                      |                             | 60               | 6                       |                  | 17,400                   |
| HMERS 4050-05-125 |                           | RO.5             |                      |                             | 60               | 6                       |                  | 17,400                   |
| HMERS 4050-10-125 |                           | R1               |                      |                             | 60               | 6                       |                  | 17,400                   |
| HMERS 6060-01-130 | 6                         | RO.1             | 13                   | —                           | 60               | 6                       | 6                | 18,600                   |
| HMERS 6060-02-130 |                           | RO.2             |                      |                             | 60               | 6                       |                  | 18,600                   |
| HMERS 6060-03-130 |                           | RO.3             |                      |                             | 60               | 6                       |                  | 18,600                   |
| HMERS 6060-05-130 |                           | RO.5             |                      |                             | 60               | 6                       |                  | 18,600                   |
| HMERS 6060-10-130 |                           | R1               |                      |                             | 60               | 6                       |                  | 18,600                   |
| HMERS 6060-15-130 |                           | R1.5             |                      |                             | 60               | 6                       |                  | 18,600                   |
| HMERS 6080-02-190 | 8                         | RO.2             | 19                   | —                           | 70               | 8                       | 6                | 23,400                   |
| HMERS 6080-03-190 |                           | RO.3             |                      |                             | 70               | 8                       |                  | 23,400                   |
| HMERS 6080-05-190 |                           | RO.5             |                      |                             | 70               | 8                       |                  | 23,400                   |
| HMERS 6080-10-190 |                           | R1               |                      |                             | 70               | 8                       |                  | 23,400                   |
| HMERS 6080-20-190 |                           | R2               |                      |                             | 70               | 8                       |                  | 23,400                   |
| HMERS 6100-02-220 | 10                        | RO.2             | 22                   | —                           | 80               | 10                      | 6                | 31,800                   |
| HMERS 6100-03-220 |                           | RO.3             |                      |                             | 80               | 10                      |                  | 31,800                   |
| HMERS 6100-05-220 |                           | RO.5             |                      |                             | 80               | 10                      |                  | 31,800                   |
| HMERS 6100-10-220 |                           | R1               |                      |                             | 80               | 10                      |                  | 31,800                   |
| HMERS 6100-15-220 |                           | R1.5             |                      |                             | 80               | 10                      |                  | 31,800                   |
| HMERS 6100-20-220 |                           | R2               |                      |                             | 80               | 10                      |                  | 31,800                   |
| HMERS 6120-02-260 | 12                        | RO.2             | 26                   | —                           | 100              | 12                      | 6                | 38,400                   |
| HMERS 6120-03-260 |                           | RO.3             |                      |                             | 100              | 12                      |                  | 38,400                   |
| HMERS 6120-05-260 |                           | RO.5             |                      |                             | 100              | 12                      |                  | 38,400                   |
| HMERS 6120-10-260 |                           | R1               |                      |                             | 100              | 12                      |                  | 38,400                   |
| HMERS 6120-15-260 |                           | R1.5             |                      |                             | 100              | 12                      |                  | 38,400                   |
| HMERS 6120-20-260 |                           | R2               |                      |                             | 100              | 12                      |                  | 38,400                   |

4 Flutes

6 Flutes

$\phi 3\text{mm}$  Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

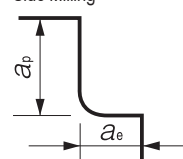
## Milling Conditions for HMERS

| WORK MATERIAL |                  |                       |                    | PREHARDENED STEELS<br>HARDENED STEELS<br>(40~50HRC) |                    |                        |                         | HARDENED STEELS<br>(50~60HRC)      |                    |                        |                         | HARDENED STEELS<br>(60HRC~)        |                    |                        |                         |
|---------------|------------------|-----------------------|--------------------|---|--------------------|------------------------|-------------------------|------------------------------------|--------------------|------------------------|-------------------------|------------------------------------|--------------------|------------------------|-------------------------|
| Model Number  | Number of Flutes | Outside Diameter (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 4030          | 4                | 3                     | 7.5                | 13,100  | 1,680              | 6                      | 0.06                    | 4,200                              | 720                | 6                      | 0.06                    | 8,600                              | 465                | 6                      | 0.06                    |
| 4040          | 4                | 4                     | 10                 | 11,300  | 1,950              | 8                      | 0.08                    | 3,150                              | 540                | 8                      | 0.08                    | 6,450                              | 350                | 8                      | 0.08                    |
| 4050          | 4                | 5                     | 12.5               | 10,100  | 2,300              | 10                     | 0.1                     | 2,520                              | 430                | 10                     | 0.1                     | 5,160                              | 280                | 10                     | 0.1                     |
| 6060          | 6                | 6                     | 13                 | 8,900   | 2,930              | 12                     | 0.12                    | 4,300                              | 1,200              | 9                      | 0.12                    | 4,300                              | 1,200              | 9                      | 0.12                    |
| 6080          | 6                | 8                     | 19                 | 4,000   | 2,400              | 12                     | 0.24                    | 3,220                              | 1,450              | 12                     | 0.08                    | 3,220                              | 1,450              | 12                     | 0.08                    |
| 6100          | 6                | 10                    | 22                 | 3,200   | 2,000              | 15                     | 0.3                     | 2,580                              | 1,160              | 15                     | 0.1                     | 2,580                              | 1,160              | 15                     | 0.1                     |
| 6120          | 6                | 12                    | 26                 | 2,670   | 1,600              | 18                     | 0.36                    | 2,150                              | 970                | 18                     | 0.12                    | 2,150                              | 970                | 18                     | 0.12                    |

Note:

- Recommend down cut processing.
- Reduce cutting amount, feed rate, and apply zero-cut in accordance with required surface quality.
- Recommend air blow or oil mist.

Side Milling



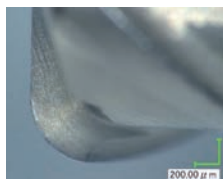
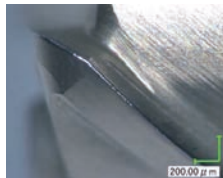
### Side Milling Example HMERS $\phi 3 \times CR0.5 \times L7.5 / \phi 10 \times CR2 \times L22$

SKH51 (63 HRC)

Tools after Milling

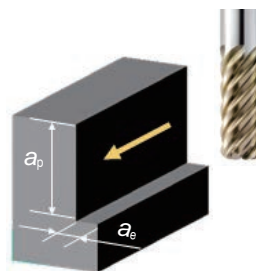
4030-05-075

6100-20-220



| Tool             | HMERS 4030-05-075<br>( $\phi 3 \times CR0.5$ ) | HMERS 6100-20-220<br>( $\phi 10 \times CR2$ ) |
|------------------|--|---|
| Spindle Speed    | 8,600 min <sup>-1</sup>                        | 2,580 min <sup>-1</sup>                       |
| Feed Rate        | 465 mm/min                                     | 1,160 mm/min                                  |
| $a_p$            | 6 mm   | 15 mm   |
| $a_e$            | 0.06 mm  | 0.1 mm  |
| Milling Distance | 12.7 m   | 28 m  |
| Coolant          | Air Blow (Through Spindle)                     |   |

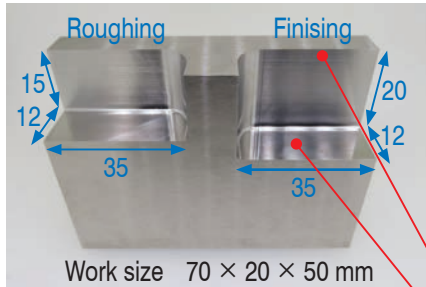
Milling Image



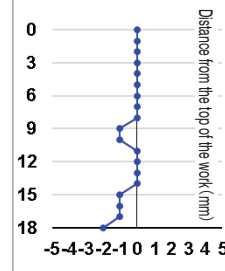
Side Milling (Down-cut)

**No chipping when milling Hard Materials.  
More tool life left.**

1. Deflection amount and surface roughness



Deflection amount (Right side finishing)



Wall surface Ra 0.21  $\mu\text{m}$   
Bottom surface Ra 0.04  $\mu\text{m}$

Coolant: Air blow (Through spindle)  
Milling direction: Down cut

**Tool**  
HMERS  $\phi 10 \times CR1 \times L22$

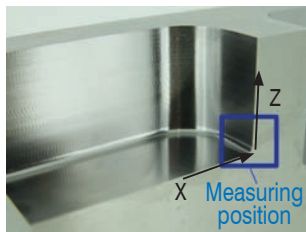


|                    | Process       | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Allowance (mm) | Cycle Time (h:m:s) |
|--------------------|---------------|------------------------------------|--------------------|------------|------------|----------------|--------------------|
| Roughing           | Roughing      | 2,580                              | 1,160              | 15         | 0.10       | 0              | 0:05:22            |
| Right side of work | Roughing      | 2,580                              | 1,160              | 20         | 0.05       | 0.05           | 0:10:38            |
|                    | Semi-Roughing |                                    | 580                | 20         | 0.04       | 0.01           | 0:25:11            |
|                    | Finishing     |                                    |                    |            | 0.01       | 0              | 1:40:43            |

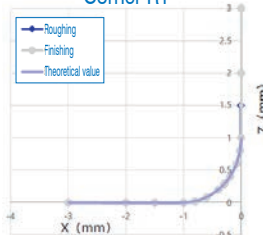
Right side total 2:16:32

2. Corner Radius measurement

R1



Corner R1



Radius accuracy (mm)  
Roughing -0.003/0.006  
Finishing 0/0.007

**High-precision machining is possible even with the bottom R.**

4 Flutes

6 Flutes

$\phi 3$ mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data





Size  $\phi 0.2 \sim \phi 6$

# HLRS2000/HLRS2000E



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●      | ●      | ○      |        |           |                 |          |        |          |                       | ○               | ○                     |                  |                                       |

Total 353 models

Unit (mm)

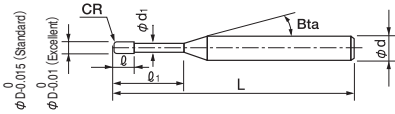
| Model Number       | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |     |    |       |
|--------------------|-----------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-----|----|-------|
| HLRS 2002-005-005E | ○         | 0.2                       | RO.05            | 0.5                       | 0.2                  | 0.17                     | 16°                   | 50               | 4                       | 12,320                   |     |    |       |
| HLRS 2002-005-010E | ○         |                           |                  | 1                         |                      |                          |                       | 50               | 4                       | 12,320                   |     |    |       |
| HLRS 2002-005-015E | ○         |                           |                  | 1.5                       |                      |                          |                       | 50               | 4                       | 12,320                   |     |    |       |
| HLRS 2002-005-020E | ○         |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 12,320                   |     |    |       |
| HLRS 2003-005-010E | ○         | 0.3                       | RO.05            | 1                         | 0.3                  | 0.27                     | 16°                   | 50               | 4                       | 11,870                   |     |    |       |
| HLRS 2003-005-015E | ○         |                           |                  | 1.5                       |                      |                          |                       | 50               | 4                       | 11,870                   |     |    |       |
| HLRS 2003-005-020E | ○         |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 11,870                   |     |    |       |
| HLRS 2003-005-025E | ○         |                           |                  | 2.5                       |                      |                          |                       | 50               | 4                       | 13,200                   |     |    |       |
| HLRS 2003-005-030E | ○         |                           |                  | 3                         |                      |                          |                       | 50               | 4                       | 13,200                   |     |    |       |
| HLRS 2004-005-010E | ○         |                           |                  | 1                         |                      |                          |                       | 0.4              | 0.4                     | 0.38                     | 16° | 50 | 4     |
| HLRS 2004-005-015E | ○         | 1.5                       | 50               | 4                         | 7,910                |                          |                       |                  |                         |                          |     |    |       |
| HLRS 2004-005-020E | ○         | 2                         | 50               | 4                         | 7,910                |                          |                       |                  |                         |                          |     |    |       |
| HLRS 2004-005-030E | ○         | 3                         | 50               | 4                         | 7,910                |                          |                       |                  |                         |                          |     |    |       |
| HLRS 2004-005-040E | ○         | 4                         | 50               | 4                         | 7,910                |                          |                       |                  |                         |                          |     |    |       |
| HLRS 2004-01-010   |           | 1                         | RO.1             | 0.5                       | 0.48                 | 16°                      | 50                    |                  |                         |                          |     | 4  | 7,910 |
| HLRS 2004-01-015   |           | 1.5                       |                  |                           |                      |                          | 50                    |                  |                         |                          |     | 4  | 7,910 |
| HLRS 2004-01-020   |           | 2                         |                  |                           |                      |                          | 50                    |                  |                         |                          |     | 4  | 7,910 |
| HLRS 2004-01-030   |           | 3                         |                  |                           |                      |                          | 50                    |                  |                         |                          |     | 4  | 7,910 |
| HLRS 2004-01-040   |           | 4                         |                  |                           |                      |                          | 50                    |                  |                         |                          |     | 4  | 7,910 |
| HLRS 2005-005-010  |           | 1                         |                  |                           |                      |                          | 0.5                   | 0.5              | 0.48                    | 16°                      | 50  | 4  | 6,440 |
| HLRS 2005-005-020  |           | 2                         |                  |                           |                      |                          |                       |                  |                         |                          | 50  | 4  | 6,440 |
| HLRS 2005-005-030  |           | 3                         |                  |                           |                      |                          |                       |                  |                         |                          | 50  | 4  | 6,440 |
| HLRS 2005-005-040  |           | 4                         | 50               | 4                         | 6,440                |                          |                       |                  |                         |                          |     |    |       |
| HLRS 2005-005-050  |           | 5                         | 50               | 4                         | 6,440                |                          |                       |                  |                         |                          |     |    |       |
| HLRS 2005-01-010   |           | 1                         | RO.1             | 0.5                       | 0.48                 | 16°                      |                       |                  |                         |                          | 50  | 4  | 6,440 |
| HLRS 2005-01-020   |           | 2                         |                  |                           |                      |                          |                       |                  |                         |                          | 50  | 4  | 6,440 |
| HLRS 2005-01-030   |           | 3                         |                  |                           |                      |                          |                       |                  |                         |                          | 50  | 4  | 6,440 |
| HLRS 2005-01-040   |           | 4                         |                  |                           |                      |                          |                       |                  |                         |                          | 50  | 4  | 6,440 |
| HLRS 2005-01-050   |           | 5                         |                  |                           |                      |                          |                       |                  |                         |                          | 50  | 4  | 6,440 |
| HLRS 2005-01-060   |           | 6                         |                  |                           |                      |                          | 50                    | 4                | 6,440                   |                          |     |    |       |

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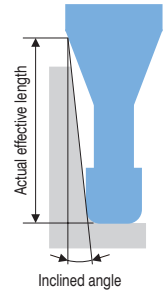


## Features

Long Neck Radius design for high efficiency and high quality milling.  
 Recommended for various applications from Copper and Raw Materials to Hard Materials.  
 Both dry and wet coolant offer stable and long tool life.  
 Refer to page 358 for 4 flute HLRS.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



|                          | Diameter Tolerance | Corner Radius Tolerance    |
|--------------------------|--------------------|----------------------------|
| Standard Tolerance Type  | 0/-0.015           | Nominal Radius $\pm$ 0.005 |
| Excellent Tolerance Type | 0/-0.01            | Nominal Radius $\pm$ 0.005 |

Unit (mm)

| Model Number       | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Effective Length by Inclined Angles |      |       |      |      |
|--------------------|-----------|---------------------------|------------------|---------------------------|-------------------------------------|------|-------|------|------|
|                    |           |                           |                  |                           | 30'                                 | 1°   | 1°30' | 2°   | 3°   |
| HLRS 2002-005-005E | ○         | 0.2                       | RO.05            | 0.5                       | 0.67                                | 0.71 | 0.75  | 0.78 | 0.85 |
| HLRS 2002-005-010E | ○         |                           |                  | 1                         | 1.20                                | 1.26 | 1.31  | 1.36 | 1.45 |
| HLRS 2002-005-015E | ○         |                           |                  | 1.5                       | 1.72                                | 1.80 | 1.87  | 1.92 | 2.03 |
| HLRS 2002-005-020E | ○         |                           |                  | 2                         | 2.25                                | 2.34 | 2.41  | 2.48 | 2.59 |
| HLRS 2003-005-010E | ○         | 0.3                       | RO.05            | 1                         | 1.24                                | 1.31 | 1.38  | 1.44 | 1.55 |
| HLRS 2003-005-015E | ○         |                           |                  | 1.5                       | 1.72                                | 1.83 | 1.91  | 1.99 | 2.12 |
| HLRS 2003-005-020E | ○         |                           |                  | 2                         | 2.26                                | 2.37 | 2.47  | 2.55 | 2.70 |
| HLRS 2003-005-025E | ○         |                           |                  | 2.5                       | 2.78                                | 2.91 | 3.02  | 3.11 | 3.27 |
| HLRS 2003-005-030E | ○         |                           |                  | 3                         | 3.31                                | 3.45 | 3.57  | 3.66 | 3.83 |
| HLRS 2004-005-010E | ○         | 0.4                       | RO.05            | 1                         | 1.31                                | 1.40 | 1.49  | 1.57 | 1.72 |
| HLRS 2004-005-015E | ○         |                           |                  | 1.5                       | 1.79                                | 1.92 | 2.03  | 2.13 | 2.31 |
| HLRS 2004-005-020E | ○         |                           |                  | 2                         | 2.33                                | 2.48 | 2.60  | 2.71 | 2.90 |
| HLRS 2004-005-030E | ○         |                           |                  | 3                         | 3.40                                | 3.58 | 3.72  | 3.85 | 4.07 |
| HLRS 2004-005-040E | ○         |                           |                  | 4                         | 4.45                                | 4.66 | 4.82  | 4.97 | 5.21 |
| HLRS 2004-01-010   |           | 0.4                       | RO.1             | 1                         | 1.28                                | 1.38 | 1.46  | 1.55 | 1.69 |
| HLRS 2004-01-015   |           |                           |                  | 1.5                       | 1.76                                | 1.90 | 2.01  | 2.11 | 2.28 |
| HLRS 2004-01-020   |           |                           |                  | 2                         | 2.30                                | 2.46 | 2.58  | 2.69 | 2.89 |
| HLRS 2004-01-030   |           |                           |                  | 3                         | 3.38                                | 3.56 | 3.71  | 3.83 | 4.06 |
| HLRS 2004-01-040   |           |                           |                  | 4                         | 4.44                                | 4.64 | 4.81  | 4.95 | 5.20 |
| HLRS 2005-005-010  |           | 0.5                       | RO.05            | 1                         | 1.34                                | 1.46 | 1.57  | 1.67 | 1.86 |
| HLRS 2005-005-020  |           |                           |                  | 2                         | 2.37                                | 2.55 | 2.71  | 2.84 | 3.08 |
| HLRS 2005-005-030  |           |                           |                  | 3                         | 3.45                                | 3.67 | 3.85  | 4.00 | 4.27 |
| HLRS 2005-005-040  |           |                           |                  | 4                         | 4.52                                | 4.77 | 4.97  | 5.14 | 5.44 |
| HLRS 2005-005-050  |           |                           |                  | 5                         | 5.58                                | 5.85 | 6.07  | 6.26 | 6.58 |
| HLRS 2005-01-010   |           | 0.5                       | RO.1             | 1                         | 1.34                                | 1.45 | 1.56  | 1.66 | 1.85 |
| HLRS 2005-01-020   |           |                           |                  | 2                         | 2.37                                | 2.55 | 2.70  | 2.83 | 3.07 |
| HLRS 2005-01-030   |           |                           |                  | 3                         | 3.45                                | 3.67 | 3.84  | 4.00 | 4.26 |
| HLRS 2005-01-040   |           |                           |                  | 4                         | 4.52                                | 4.76 | 4.96  | 5.13 | 5.43 |
| HLRS 2005-01-050   |           |                           |                  | 5                         | 5.58                                | 5.85 | 6.07  | 6.25 | 6.57 |
| HLRS 2005-01-060   |           |                           |                  | 6                         | 6.63                                | 6.93 | 7.16  | 7.36 | 7.70 |

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φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Unit (mm)

| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |       |       |       |       |       |    |       |       |
|-------------------|-----------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------|-------|-------|-------|-------|----|-------|-------|
| HLRS 2006-005-020 |           | 0.6                       | RO.05            | 2                         | 0.6                  | 0.58                     | 16°                   | 50               | 4                       | 6,440                    |       |       |       |       |       |    |       |       |
| HLRS 2006-005-030 |           |                           |                  | 3                         |                      |                          |                       | 50               | 4                       | 6,440                    |       |       |       |       |       |    |       |       |
| HLRS 2006-005-040 |           |                           |                  | 4                         |                      |                          |                       | 50               | 4                       | 6,440                    |       |       |       |       |       |    |       |       |
| HLRS 2006-005-060 |           |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 6,440                    |       |       |       |       |       |    |       |       |
| HLRS 2006-005-080 |           |                           |                  | 8                         |                      |                          |                       | 50               | 4                       | 6,440                    |       |       |       |       |       |    |       |       |
| HLRS 2006-01-020  |           |                           |                  | 2                         |                      |                          |                       | RO.1             | 2                       | 50                       | 4     | 6,440 |       |       |       |    |       |       |
| HLRS 2006-01-020E | ○         |                           | 2                | 50                        |                      |                          |                       |                  | 4                       | 7,080                    |       |       |       |       |       |    |       |       |
| HLRS 2006-01-030  |           |                           | 3                | 50                        |                      |                          |                       |                  | 4                       | 6,440                    |       |       |       |       |       |    |       |       |
| HLRS 2006-01-030E | ○         |                           | 3                | 50                        |                      |                          |                       |                  | 4                       | 7,080                    |       |       |       |       |       |    |       |       |
| HLRS 2006-01-040  |           |                           | 4                | 50                        |                      |                          |                       |                  | 4                       | 6,440                    |       |       |       |       |       |    |       |       |
| HLRS 2006-01-040E | ○         |                           | 4                | 50                        |                      |                          |                       |                  | 4                       | 7,080                    |       |       |       |       |       |    |       |       |
| HLRS 2006-01-060  |           |                           | 6                | 50                        |                      |                          |                       |                  | 4                       | 6,440                    |       |       |       |       |       |    |       |       |
| HLRS 2006-01-080  |           |                           | 8                | 50                        |                      |                          |                       |                  | 4                       | 6,440                    |       |       |       |       |       |    |       |       |
| HLRS 2006-02-020  |           |                           | 2                | RO.2                      |                      |                          |                       |                  | 2                       | 50                       | 4     | 6,440 |       |       |       |    |       |       |
| HLRS 2006-02-030  |           |                           | 3                |                           |                      |                          |                       |                  | 50                      | 4                        | 6,440 |       |       |       |       |    |       |       |
| HLRS 2006-02-040  |           |                           | 4                |                           |                      |                          |                       | 50               | 4                       | 6,440                    |       |       |       |       |       |    |       |       |
| HLRS 2006-02-060  |           | 6                         | 50               |                           | 4                    | 6,440                    |                       |                  |                         |                          |       |       |       |       |       |    |       |       |
| HLRS 2006-02-080  |           | 8                         | 50               |                           | 4                    | 6,440                    |                       |                  |                         |                          |       |       |       |       |       |    |       |       |
| HLRS 2007-01-040  |           | 0.7                       | RO.1             |                           | 4                    | 0.7                      | 0.68                  | 16°              | 50                      | 4                        | 6,780 |       |       |       |       |    |       |       |
| HLRS 2007-01-060  |           |                           |                  | 6                         | 50                   |                          |                       |                  | 4                       | 6,780                    |       |       |       |       |       |    |       |       |
| HLRS 2007-02-040  |           |                           |                  | 4                         | RO.2                 |                          |                       |                  | 4                       | 50                       | 4     | 6,780 |       |       |       |    |       |       |
| HLRS 2007-02-060  |           |                           | 6                | 50                        |                      |                          |                       |                  | 4                       | 6,780                    |       |       |       |       |       |    |       |       |
| HLRS 2008-005-040 |           |                           | 4                | RO.05                     |                      |                          |                       |                  | 4                       | 0.8                      | 0.78  | 16°   | 50    | 4     | 7,340 |    |       |       |
| HLRS 2008-005-060 |           |                           | 6                |                           | 50                   |                          |                       |                  | 4                       |                          |       |       | 7,340 |       |       |    |       |       |
| HLRS 2008-005-080 |           | 8                         | 50               |                           | 4                    | 7,340                    |                       |                  |                         |                          |       |       |       |       |       |    |       |       |
| HLRS 2008-01-040  |           | 4                         | RO.1             |                           | 4                    | 0.8                      | 0.78                  | 16°              | 50                      |                          |       |       | 4     | 7,340 |       |    |       |       |
| HLRS 2008-01-060  |           | 6                         |                  |                           | 50                   |                          |                       |                  | 4                       |                          |       |       | 7,340 |       |       |    |       |       |
| HLRS 2008-01-080  |           | 8                         |                  |                           | 50                   |                          |                       |                  | 4                       |                          |       |       | 7,340 |       |       |    |       |       |
| HLRS 2008-02-040  |           | 4                         |                  |                           | RO.2                 |                          |                       |                  | 4                       |                          |       |       | 0.8   | 0.78  | 16°   | 50 | 4     | 7,340 |
| HLRS 2008-02-060  |           | 6                         |                  |                           |                      |                          |                       |                  | 50                      |                          |       |       |       |       |       | 4  | 7,340 |       |
| HLRS 2008-02-080  |           | 8                         |                  |                           |                      |                          |                       |                  | 50                      |                          |       |       |       |       |       | 4  | 7,340 |       |
| HLRS 2010-005-020 |           | 1                         | RO.05            |                           |                      | 2                        | 1                     | 0.95             | 16°                     |                          |       |       |       |       |       | 50 | 4     | 6,240 |
| HLRS 2010-005-030 |           |                           |                  | 3                         | 50                   | 4                        |                       |                  |                         | 6,240                    |       |       |       |       |       |    |       |       |
| HLRS 2010-005-040 |           |                           |                  | 4                         | 50                   | 4                        |                       |                  |                         | 6,240                    |       |       |       |       |       |    |       |       |
| HLRS 2010-005-050 |           |                           |                  | 5                         | 50                   | 4                        |                       |                  |                         | 6,240                    |       |       |       |       |       |    |       |       |
| HLRS 2010-005-060 |           |                           |                  | 6                         | 50                   | 4                        |                       |                  |                         | 6,780                    |       |       |       |       |       |    |       |       |
| HLRS 2010-005-080 |           |                           |                  | 8                         | 50                   | 4                        |                       |                  |                         | 6,780                    |       |       |       |       |       |    |       |       |
| HLRS 2010-005-100 |           |                           |                  | 10                        | 50                   | 4                        |                       |                  |                         | 6,780                    |       |       |       |       |       |    |       |       |
| HLRS 2010-005-120 |           |                           |                  | 12                        | 55                   | 4                        |                       |                  |                         | 6,780                    |       |       |       |       |       |    |       |       |
| HLRS 2010-005-160 |           |                           |                  | 16                        | 60                   | 4                        |                       |                  |                         | 8,990                    |       |       |       |       |       |    |       |       |
| HLRS 2010-005-200 |           |                           |                  | 20                        | 60                   | 4                        |                       |                  |                         | 9,980                    |       |       |       |       |       |    |       |       |
| HLRS 2010-01-020  |           |                           | 2                | RO.1                      | 2                    | 1                        |                       |                  |                         | 0.95                     | 16°   | 50    | 4     | 6,240 |       |    |       |       |
| HLRS 2010-01-020E | ○         |                           | 2                |                           | 50                   |                          |                       |                  |                         |                          |       | 4     | 6,860 |       |       |    |       |       |
| HLRS 2010-01-030  |           |                           | 3                |                           | 50                   |                          |                       |                  |                         |                          |       | 4     | 6,240 |       |       |    |       |       |
| HLRS 2010-01-040  |           |                           | 4                |                           | 50                   |                          |                       |                  |                         |                          |       | 4     | 6,240 |       |       |    |       |       |
| HLRS 2010-01-040E | ○         |                           | 4                |                           | 50                   |                          |                       |                  |                         |                          |       | 4     | 6,860 |       |       |    |       |       |
| HLRS 2010-01-050  |           |                           | 5                |                           | 50                   |                          |                       |                  |                         |                          |       | 4     | 6,240 |       |       |    |       |       |
| HLRS 2010-01-060  |           |                           | 6                |                           | 50                   |                          |                       |                  |                         |                          |       | 4     | 6,780 |       |       |    |       |       |
| HLRS 2010-01-060E | ○         |                           | 6                |                           | 50                   |                          |                       |                  |                         |                          |       | 4     | 7,460 |       |       |    |       |       |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |       |       |       |       |      |
|-------------------|-----------|---------------------------|------------------|------------------------|-------------------------------------|-------|-------|-------|-------|------|
|                   |           |                           |                  |                        | 30°                                 | 1°    | 1°30' | 2°    | 3°    |      |
| HLRS 2006-005-020 |           | 0.6                       | RO.05            | 2                      | 2.38                                | 2.61  | 2.79  | 2.95  | 3.22  |      |
| HLRS 2006-005-030 |           |                           |                  | 3                      | 3.48                                | 3.74  | 3.95  | 4.13  | 4.30  |      |
| HLRS 2006-005-040 |           |                           |                  | 4                      | 4.56                                | 4.85  | 5.08  | 5.28  | 5.67  |      |
| HLRS 2006-005-060 |           |                           |                  | 6                      | 6.68                                | 7.03  | 7.30  | 7.55  | 8.12  |      |
| HLRS 2006-005-080 |           |                           |                  | 8                      | 8.79                                | 9.18  | 9.50  | 9.83  | 10.56 |      |
| HLRS 2006-01-020  |           |                           | RO.1             | 2                      | 2.37                                | 2.60  | 2.78  | 2.93  | 3.20  |      |
| HLRS 2006-01-020E | ○         |                           |                  | 2                      | 2.37                                | 2.60  | 2.78  | 2.93  | 3.20  |      |
| HLRS 2006-01-030  |           |                           |                  | 3                      | 3.47                                | 3.73  | 3.94  | 4.11  | 4.28  |      |
| HLRS 2006-01-030E | ○         |                           |                  | 3                      | 3.47                                | 3.73  | 3.94  | 4.11  | 4.28  |      |
| HLRS 2006-01-040  |           |                           |                  | 4                      | 4.55                                | 4.84  | 5.07  | 5.26  | 5.65  |      |
| HLRS 2006-01-040E | ○         |                           |                  | 4                      | 4.55                                | 4.84  | 5.07  | 5.26  | 5.65  |      |
| HLRS 2006-01-060  |           |                           |                  | 6                      | 6.68                                | 7.03  | 7.30  | 7.54  | 8.10  |      |
| HLRS 2006-01-080  |           |                           |                  | 8                      | 8.79                                | 9.18  | 9.50  | 9.82  | 10.55 |      |
| HLRS 2006-02-020  |           |                           |                  | RO.2                   | 2                                   | 2.34  | 2.56  | 2.74  | 2.90  | 3.18 |
| HLRS 2006-02-030  |           |                           |                  |                        | 3                                   | 3.44  | 3.70  | 3.91  | 4.09  | 4.41 |
| HLRS 2006-02-040  |           |                           | 4                |                        | 4.53                                | 4.82  | 5.05  | 5.23  | 5.61  |      |
| HLRS 2006-02-060  |           |                           | 6                |                        | 6.66                                | 7.01  | 7.28  | 7.51  | 8.06  |      |
| HLRS 2006-02-080  |           |                           | 8                |                        | 8.79                                | 9.17  | 9.48  | 9.81  | 10.53 |      |
| HLRS 2007-01-040  |           |                           | 0.7              | RO.1                   | 4                                   | 4.55  | 4.84  | 5.07  | 5.26  | 5.65 |
| HLRS 2007-01-060  |           |                           |                  |                        | 6                                   | 6.68  | 7.03  | 7.30  | 7.54  | 8.10 |
| HLRS 2007-02-040  |           | RO.2                      |                  | 4                      | 4.53                                | 4.82  | 5.05  | 5.23  | 5.61  |      |
| HLRS 2007-02-060  |           |                           |                  | 6                      | 6.66                                | 7.01  | 7.28  | 7.51  | 8.06  |      |
| HLRS 2008-005-040 |           | 0.8                       | RO.05            | 4                      | 4.56                                | 4.85  | 5.08  | 5.28  | 5.67  |      |
| HLRS 2008-005-060 |           |                           |                  | 6                      | 6.68                                | 7.03  | 7.30  | 7.55  | 8.12  |      |
| HLRS 2008-005-080 |           |                           |                  | 8                      | 8.79                                | 9.18  | 9.50  | 9.83  | 10.56 |      |
| HLRS 2008-01-040  |           |                           | RO.1             | 4                      | 4.55                                | 4.84  | 5.07  | 5.26  | 5.65  |      |
| HLRS 2008-01-060  |           |                           |                  | 6                      | 6.68                                | 7.03  | 7.30  | 7.54  | 8.10  |      |
| HLRS 2008-01-080  |           |                           |                  | 8                      | 8.79                                | 9.18  | 9.50  | 9.82  | 10.55 |      |
| HLRS 2008-02-040  |           |                           | RO.2             | 4                      | 4.53                                | 4.82  | 5.05  | 5.23  | 5.61  |      |
| HLRS 2008-02-060  |           |                           |                  | 6                      | 6.66                                | 7.01  | 7.28  | 7.51  | 8.06  |      |
| HLRS 2008-02-080  |           |                           |                  | 8                      | 8.79                                | 9.17  | 9.48  | 9.81  | 10.53 |      |
| HLRS 2010-005-020 |           |                           |                  | 1                      | RO.05                               | 2     | 2.51  | 2.86  | 2.70  | 3.01 |
| HLRS 2010-005-030 |           | 3                         | 3.59             |                        |                                     | 3.82  | 4.01  | 4.18  | 4.51  |      |
| HLRS 2010-005-040 |           | 4                         | 4.72             |                        |                                     | 4.92  | 5.14  | 5.33  | 5.73  |      |
| HLRS 2010-005-050 |           | 5                         | 5.72             |                        |                                     | 6.01  | 6.25  | 6.47  | 6.95  |      |
| HLRS 2010-005-060 |           | 6                         | 6.77             |                        |                                     | 7.09  | 7.35  | 7.61  | 8.18  |      |
| HLRS 2010-005-080 |           | 8                         | 8.87             |                        |                                     | 9.24  | 9.55  | 9.88  | 10.62 |      |
| HLRS 2010-005-100 |           | 10                        | 10.97            |                        |                                     | 11.37 | 11.75 | 12.16 | 13.07 |      |
| HLRS 2010-005-120 |           | 12                        | 13.05            |                        |                                     | 13.50 | 13.96 | 14.44 | 15.52 |      |
| HLRS 2010-005-160 |           | 16                        | 17.20            |                        |                                     | 17.76 | 18.36 | 18.99 | 20.41 |      |
| HLRS 2010-005-200 |           | 20                        | 21.33            |                        |                                     | 22.02 | 22.76 | 23.55 | 25.31 |      |
| HLRS 2010-01-020  |           | RO.1                      | 2                |                        | 2.53                                | 2.71  | 2.88  | 3.01  | 3.27  |      |
| HLRS 2010-01-020E | ○         |                           | 2                |                        | 2.53                                | 2.71  | 2.88  | 3.01  | 3.27  |      |
| HLRS 2010-01-030  |           |                           | 3                |                        | 3.58                                | 3.81  | 4.00  | 4.18  | 4.49  |      |
| HLRS 2010-01-040  |           |                           | 4                |                        | 4.67                                | 4.93  | 5.14  | 5.33  | 5.72  |      |
| HLRS 2010-01-040E | ○         |                           | 4                |                        | 4.67                                | 4.93  | 5.14  | 5.33  | 5.72  |      |
| HLRS 2010-01-050  |           |                           | 5                |                        | 5.71                                | 6.00  | 6.24  | 6.46  | 6.94  |      |
| HLRS 2010-01-060  |           |                           | 6                |                        | 6.78                                | 7.10  | 7.36  | 7.60  | 8.17  |      |
| HLRS 2010-01-060E | ○         |                           | 6                |                        | 6.78                                | 7.10  | 7.36  | 7.60  | 8.17  |      |

| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |     |    |       |       |
|-------------------|-----------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-----|----|-------|-------|
| HLRS 2010-01-080  |           | 1                         | RO.1             | 8                         | 1                    | 0.95                     | 16°                   | 50               | 4                       | 6,780                    |     |    |       |       |
| HLRS 2010-01-100  |           |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 6,780                    |     |    |       |       |
| HLRS 2010-01-120  |           |                           |                  | 12                        |                      |                          |                       | 55               | 4                       | 6,780                    |     |    |       |       |
| HLRS 2010-01-160  |           |                           |                  | 16                        |                      |                          |                       | 60               | 4                       | 8,990                    |     |    |       |       |
| HLRS 2010-01-200  |           |                           |                  | 20                        |                      |                          |                       | 60               | 4                       | 9,980                    |     |    |       |       |
| HLRS 2010-02-020  |           |                           | 1                | RO.2                      |                      |                          |                       | 2                | 1                       | 0.95                     | 16° | 50 | 4     | 6,240 |
| HLRS 2010-02-020E | ○         |                           |                  |                           |                      |                          |                       | 2                |                         |                          |     | 50 | 4     | 6,860 |
| HLRS 2010-02-030  |           |                           |                  |                           |                      |                          |                       | 3                |                         |                          |     | 50 | 4     | 6,240 |
| HLRS 2010-02-040  |           |                           |                  |                           |                      |                          |                       | 4                |                         |                          |     | 50 | 4     | 6,240 |
| HLRS 2010-02-040E | ○         |                           |                  |                           |                      |                          |                       | 4                |                         |                          |     | 50 | 4     | 6,860 |
| HLRS 2010-02-050  |           |                           |                  | 5                         |                      |                          |                       | 50               |                         |                          |     | 4  | 6,240 |       |
| HLRS 2010-02-060  |           |                           |                  | RO.2                      |                      |                          |                       | 6                |                         |                          |     | 50 | 4     | 6,780 |
| HLRS 2010-02-060E | ○         |                           |                  |                           |                      |                          |                       | 6                |                         |                          |     | 50 | 4     | 7,460 |
| HLRS 2010-02-080  |           |                           |                  |                           |                      |                          |                       | 8                |                         |                          |     | 50 | 4     | 6,780 |
| HLRS 2010-02-100  |           |                           |                  |                           |                      |                          |                       | 10               |                         |                          |     | 50 | 4     | 6,780 |
| HLRS 2010-02-120  |           |                           |                  |                           |                      |                          |                       | 12               |                         |                          |     | 55 | 4     | 6,780 |
| HLRS 2010-02-160  |           |                           |                  | RO.3                      |                      |                          |                       | 16               |                         |                          |     | 60 | 4     | 8,990 |
| HLRS 2010-02-200  |           |                           |                  |                           |                      |                          |                       | 20               |                         |                          |     | 60 | 4     | 9,980 |
| HLRS 2010-03-020  |           |                           |                  |                           |                      |                          |                       | 2                |                         |                          |     | 50 | 4     | 6,240 |
| HLRS 2010-03-020E | ○         |                           |                  |                           |                      |                          |                       | 2                |                         |                          |     | 50 | 4     | 6,860 |
| HLRS 2010-03-030  |           | 3                         |                  |                           | 50                   | 4                        | 6,240                 |                  |                         |                          |     |    |       |       |
| HLRS 2010-03-040  |           | RO.3                      |                  | 4                         | 50                   | 4                        | 6,240                 |                  |                         |                          |     |    |       |       |
| HLRS 2010-03-040E | ○         |                           |                  | 4                         | 50                   | 4                        | 6,860                 |                  |                         |                          |     |    |       |       |
| HLRS 2010-03-050  |           |                           |                  | 5                         | 50                   | 4                        | 6,240                 |                  |                         |                          |     |    |       |       |
| HLRS 2010-03-060  |           |                           |                  | 6                         | 50                   | 4                        | 6,780                 |                  |                         |                          |     |    |       |       |
| HLRS 2010-03-060E | ○         |                           | 6                | 50                        | 4                    | 7,460                    |                       |                  |                         |                          |     |    |       |       |
| HLRS 2010-03-080  |           |                           | 8                | 50                        | 4                    | 6,780                    |                       |                  |                         |                          |     |    |       |       |
| HLRS 2010-03-100  |           |                           | 10               | 50                        | 4                    | 6,780                    |                       |                  |                         |                          |     |    |       |       |
| HLRS 2010-03-120  |           |                           | 12               | 55                        | 4                    | 6,780                    |                       |                  |                         |                          |     |    |       |       |
| HLRS 2010-03-160  |           |                           | 16               | 60                        | 4                    | 8,990                    |                       |                  |                         |                          |     |    |       |       |
| HLRS 2010-03-200  |           |                           | 20               | 60                        | 4                    | 9,980                    |                       |                  |                         |                          |     |    |       |       |
| HLRS 2012-02-060  |           | 1.2                       | RO.2             | 6                         | 1.2                  | 1.14                     | 16°                   | 50               | 4                       | 7,000                    |     |    |       |       |
| HLRS 2012-02-120  |           |                           |                  | 12                        |                      |                          |                       | 55               | 4                       | 7,000                    |     |    |       |       |
| HLRS 2012-02-200  |           |                           |                  | 20                        |                      |                          |                       | 60               | 4                       | 10,620                   |     |    |       |       |
| HLRS 2012-03-060  |           |                           | RO.3             | 6                         |                      |                          |                       | 50               | 4                       | 7,000                    |     |    |       |       |
| HLRS 2012-03-120  |           |                           |                  | 12                        |                      |                          |                       | 55               | 4                       | 7,000                    |     |    |       |       |
| HLRS 2012-03-200  |           | 20                        | 60               | 4                         | 10,620               |                          |                       |                  |                         |                          |     |    |       |       |
| HLRS 2015-005-040 |           | 1.5                       | RO.05            | 4                         | 1.5                  | 1.45                     | 16°                   | 50               | 4                       | 6,650                    |     |    |       |       |
| HLRS 2015-005-060 |           |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 6,650                    |     |    |       |       |
| HLRS 2015-005-080 |           |                           |                  | 8                         |                      |                          |                       | 50               | 4                       | 7,000                    |     |    |       |       |
| HLRS 2015-005-100 |           |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 7,000                    |     |    |       |       |
| HLRS 2015-01-040  |           |                           | RO.1             | 4                         |                      |                          |                       | 50               | 4                       | 6,650                    |     |    |       |       |
| HLRS 2015-01-060  |           |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 6,650                    |     |    |       |       |
| HLRS 2015-01-080  |           |                           |                  | 8                         |                      |                          |                       | 50               | 4                       | 7,000                    |     |    |       |       |
| HLRS 2015-01-100  |           |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 7,000                    |     |    |       |       |
| HLRS 2015-01-120  |           |                           |                  | 12                        |                      |                          |                       | 55               | 4                       | 7,000                    |     |    |       |       |
| HLRS 2015-01-160  |           |                           |                  | 16                        |                      |                          |                       | 55               | 4                       | 7,000                    |     |    |       |       |
| HLRS 2015-01-200  |           | 20                        | 60               | 4                         | 7,000                |                          |                       |                  |                         |                          |     |    |       |       |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |       |       |       |                 |       |
|-------------------|-----------|---------------------------|------------------|------------------------|-------------------------------------|-------|-------|-------|-----------------|-------|
|                   |           |                           |                  |                        | 30°                                 | 1°    | 1°30' | 2°    | 3°              |       |
| HLRS 2010-01-080  |           | 1                         | RO.1             | 8                      | 8.88                                | 9.24  | 9.56  | 9.88  | 10.61           |       |
| HLRS 2010-01-100  |           |                           |                  | 10                     | 10.97                               | 11.37 | 11.76 | 12.16 | 13.06           |       |
| HLRS 2010-01-120  |           |                           |                  | 12                     | 13.05                               | 13.50 | 13.96 | 14.44 | 15.51           |       |
| HLRS 2010-01-160  |           |                           |                  | 16                     | 17.20                               | 17.76 | 18.36 | 18.99 | 20.40           |       |
| HLRS 2010-01-200  |           |                           |                  | 20                     | 21.33                               | 22.02 | 22.76 | 23.54 | 25.30           |       |
| HLRS 2010-02-020  |           |                           |                  | RO.2                   | 2                                   | 2.51  | 2.69  | 2.86  | 2.98            | 3.23  |
| HLRS 2010-02-020E | ○         |                           | 2                |                        | 2.51                                | 2.69  | 2.86  | 2.98  | 3.23            |       |
| HLRS 2010-02-030  |           |                           | 3                |                        | 3.58                                | 3.80  | 3.99  | 4.16  | 4.47            |       |
| HLRS 2010-02-040  |           |                           | 4                |                        | 4.65                                | 4.91  | 5.12  | 5.30  | 5.68            |       |
| HLRS 2010-02-040E | ○         |                           | 4                |                        | 4.65                                | 4.91  | 5.12  | 5.30  | 5.68            |       |
| HLRS 2010-02-050  |           |                           | 5                |                        | 5.71                                | 6.00  | 6.23  | 6.45  | 6.92            |       |
| HLRS 2010-02-060  |           |                           | 6                |                        | 6.76                                | 7.08  | 7.34  | 7.57  | 8.13            |       |
| HLRS 2010-02-060E | ○         |                           | 6                |                        | 6.76                                | 7.08  | 7.34  | 7.57  | 8.13            |       |
| HLRS 2010-02-080  |           |                           | 8                |                        | 8.86                                | 9.22  | 9.54  | 9.85  | 10.57           |       |
| HLRS 2010-02-100  |           |                           | 10               |                        | 10.95                               | 11.35 | 11.74 | 12.13 | 13.02           |       |
| HLRS 2010-02-120  |           |                           | 12               |                        | 13.03                               | 13.48 | 13.94 | 14.41 | 15.47           |       |
| HLRS 2010-02-160  |           |                           | 16               |                        | 17.18                               | 17.74 | 18.34 | 18.96 | 20.36           |       |
| HLRS 2010-02-200  |           |                           | 20               | 21.31                  | 22.00                               | 22.74 | 23.51 | 25.26 |                 |       |
| HLRS 2010-03-020  |           |                           | RO.3             | 2                      | 2.49                                | 2.67  | 2.84  | 2.95  | 3.19            |       |
| HLRS 2010-03-020E | ○         |                           |                  | 2                      | 2.49                                | 2.67  | 2.84  | 2.95  | 3.19            |       |
| HLRS 2010-03-030  |           |                           |                  | 3                      | 3.57                                | 3.79  | 3.98  | 4.14  | 4.45            |       |
| HLRS 2010-03-040  |           |                           |                  | 4                      | 4.63                                | 4.89  | 5.10  | 5.27  | 5.64            |       |
| HLRS 2010-03-040E | ○         |                           |                  | 4                      | 4.63                                | 4.89  | 5.10  | 5.27  | 5.64            |       |
| HLRS 2010-03-050  |           |                           |                  | 5                      | 5.70                                | 5.99  | 6.22  | 6.43  | 6.90            |       |
| HLRS 2010-03-060  |           |                           |                  | 6                      | 6.74                                | 7.06  | 7.32  | 7.54  | 8.09            |       |
| HLRS 2010-03-060E | ○         |                           |                  | 6                      | 6.74                                | 7.06  | 7.32  | 7.54  | 8.09            |       |
| HLRS 2010-03-080  |           |                           |                  | 8                      | 8.84                                | 9.20  | 9.52  | 9.82  | 10.53           |       |
| HLRS 2010-03-100  |           |                           |                  | 10                     | 10.93                               | 11.33 | 11.72 | 12.10 | 12.98           |       |
| HLRS 2010-03-120  |           |                           |                  | 12                     | 13.01                               | 13.46 | 13.92 | 14.38 | 15.43           |       |
| HLRS 2010-03-160  |           |                           |                  | 16                     | 17.16                               | 17.72 | 18.32 | 18.93 | 20.32           |       |
| HLRS 2010-03-200  |           |                           | 20               | 21.29                  | 21.98                               | 22.72 | 23.48 | 25.22 |                 |       |
| HLRS 2012-02-060  |           |                           | 1.2              | RO.2                   | 6                                   | 6.18  | 6.38  | 6.59  | 6.82            | 7.33  |
| HLRS 2012-02-120  |           |                           |                  |                        | 12                                  | 12.37 | 12.77 | 13.19 | 13.65           | 14.67 |
| HLRS 2012-02-200  |           |                           |                  |                        | 20                                  | 20.62 | 21.29 | 22.00 | 22.76           | 24.46 |
| HLRS 2012-03-060  |           |                           |                  | RO.3                   | 6                                   | 6.18  | 6.38  | 6.59  | 6.81            | 7.31  |
| HLRS 2012-03-120  |           |                           |                  |                        | 12                                  | 12.37 | 12.77 | 13.19 | 13.64           | 14.66 |
| HLRS 2012-03-200  |           | 20                        |                  |                        | 20.62                               | 21.28 | 21.99 | 22.75 | 24.45           |       |
| HLRS 2015-005-040 |           | 1.5                       | RO.05            | 4                      | 4.12                                | 4.26  | 4.40  | 4.55  | 4.89            |       |
| HLRS 2015-005-060 |           |                           |                  | 6                      | 6.18                                | 6.39  | 6.60  | 6.83  | 7.34            |       |
| HLRS 2015-005-080 |           |                           |                  | 8                      | 8.25                                | 8.52  | 8.80  | 9.11  | 9.79            |       |
| HLRS 2015-005-100 |           |                           |                  | 10                     | 10.31                               | 10.64 | 11.00 | 11.38 | 12.24           |       |
| HLRS 2015-01-040  |           |                           | RO.1             | 4                      | 4.12                                | 4.25  | 4.40  | 4.55  | 4.89            |       |
| HLRS 2015-01-060  |           |                           |                  | 6                      | 6.18                                | 6.38  | 6.60  | 6.83  | 7.34            |       |
| HLRS 2015-01-080  |           |                           |                  | 8                      | 8.24                                | 8.51  | 8.80  | 9.10  | 9.78            |       |
| HLRS 2015-01-100  |           |                           |                  | 10                     | 10.31                               | 10.64 | 11.00 | 11.38 | 12.23           |       |
| HLRS 2015-01-120  |           |                           |                  | 12                     | 12.37                               | 12.77 | 13.20 | 13.66 | 14.68           |       |
| HLRS 2015-01-160  |           |                           |                  | 16                     | 16.50                               | 17.03 | 17.60 | 18.21 | 19.57           |       |
| HLRS 2015-01-200  |           |                           |                  | 20                     | 20.62                               | 21.29 | 22.00 | 22.77 | No Interference |       |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |       |
|-------------------|-----------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------|
| HLRS 2015-02-040  |           | 1.5                       | RO.2             | 4                         | 1.5                  | 1.45                     | 16°                   | 50               | 4                       | 6,650                    |       |
| HLRS 2015-02-060  |           |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 6,650                    |       |
| HLRS 2015-02-080  |           |                           |                  | 8                         |                      |                          |                       | 50               | 4                       | 7,000                    |       |
| HLRS 2015-02-100  |           |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 7,000                    |       |
| HLRS 2015-02-120  |           |                           |                  | 12                        |                      |                          |                       | 55               | 4                       | 7,000                    |       |
| HLRS 2015-02-160  |           |                           |                  | 16                        |                      |                          |                       | 55               | 4                       | 7,000                    |       |
| HLRS 2015-02-200  |           |                           |                  | 20                        |                      |                          |                       | 60               | 4                       | 7,000                    |       |
| HLRS 2015-03-040  |           |                           |                  | RO.3                      |                      |                          |                       | 4                | 50                      | 4                        | 6,650 |
| HLRS 2015-03-060  |           |                           | 6                |                           |                      |                          |                       | 50               | 4                       | 6,650                    |       |
| HLRS 2015-03-080  |           |                           | 8                |                           |                      |                          |                       | 50               | 4                       | 7,000                    |       |
| HLRS 2015-03-100  |           |                           | 10               |                           |                      |                          |                       | 50               | 4                       | 7,000                    |       |
| HLRS 2015-03-120  |           |                           | 12               |                           |                      |                          |                       | 55               | 4                       | 7,000                    |       |
| HLRS 2015-03-160  |           |                           | 16               |                           |                      |                          |                       | 55               | 4                       | 7,000                    |       |
| HLRS 2015-03-200  |           |                           | 20               |                           |                      |                          |                       | 60               | 4                       | 7,000                    |       |
| HLRS 2015-05-040  |           |                           | RO.5             |                           |                      |                          |                       | 4                | 50                      | 4                        | 6,650 |
| HLRS 2015-05-060  |           |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 6,650                    |       |
| HLRS 2015-05-080  |           |                           |                  | 8                         |                      |                          |                       | 50               | 4                       | 7,000                    |       |
| HLRS 2015-05-100  |           |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 7,000                    |       |
| HLRS 2015-05-120  |           |                           |                  | 12                        |                      |                          |                       | 55               | 4                       | 7,000                    |       |
| HLRS 2015-05-160  |           |                           |                  | 16                        |                      |                          |                       | 55               | 4                       | 7,000                    |       |
| HLRS 2015-05-200  |           | 20                        |                  | 60                        | 4                    | 7,000                    |                       |                  |                         |                          |       |
| HLRS 2020-005-040 |           | 2                         |                  | RO.05                     | 4                    | 2                        | 1.92                  | 16°              | 50                      | 4                        | 6,650 |
| HLRS 2020-005-060 |           |                           | 6                |                           | 50                   |                          |                       |                  | 4                       | 6,650                    |       |
| HLRS 2020-005-080 |           |                           | 8                |                           | 50                   |                          |                       |                  | 4                       | 7,000                    |       |
| HLRS 2020-005-100 |           |                           | 10               |                           | 50                   |                          |                       |                  | 4                       | 7,000                    |       |
| HLRS 2020-01-040  |           |                           | 4                |                           | 50                   |                          |                       |                  | 4                       | 6,650                    |       |
| HLRS 2020-01-040E | ○         |                           | 4                | 50                        | 4                    |                          |                       |                  | 7,320                   |                          |       |
| HLRS 2020-01-060  |           |                           | 6                | 50                        | 4                    |                          |                       |                  | 6,650                   |                          |       |
| HLRS 2020-01-060E | ○         |                           | 6                | 50                        | 4                    |                          |                       |                  | 7,320                   |                          |       |
| HLRS 2020-01-080  |           |                           | 8                | 50                        | 4                    |                          |                       |                  | 7,000                   |                          |       |
| HLRS 2020-01-080E | ○         |                           | 8                | 50                        | 4                    |                          |                       |                  | 7,700                   |                          |       |
| HLRS 2020-01-100  |           |                           | RO.1             | 10                        | 50                   |                          |                       |                  | 4                       | 7,000                    |       |
| HLRS 2020-01-100E | ○         |                           |                  | 10                        | 50                   |                          |                       |                  | 4                       | 7,700                    |       |
| HLRS 2020-01-120  |           |                           |                  | 12                        | 55                   |                          |                       |                  | 4                       | 7,000                    |       |
| HLRS 2020-01-120E | ○         |                           |                  | 12                        | 55                   |                          |                       |                  | 4                       | 7,700                    |       |
| HLRS 2020-01-160  |           |                           |                  | 16                        | 60                   |                          |                       |                  | 4                       | 7,000                    |       |
| HLRS 2020-01-200  |           |                           |                  | 20                        | 60                   |                          |                       |                  | 4                       | 7,000                    |       |
| HLRS 2020-01-260  |           |                           |                  | 26                        | 70                   |                          |                       |                  | 4                       | 7,000                    |       |
| HLRS 2020-01-300  |           |                           |                  | 30                        | 70                   |                          |                       |                  | 4                       | 7,000                    |       |
| HLRS 2020-02-040  |           |                           |                  | RO.2                      | 4                    |                          |                       |                  | 50                      | 4                        | 6,650 |
| HLRS 2020-02-040E | ○         |                           |                  |                           | 4                    |                          |                       |                  | 50                      | 4                        | 7,320 |
| HLRS 2020-02-060  |           | 6                         | 50               |                           | 4                    | 6,650                    |                       |                  |                         |                          |       |
| HLRS 2020-02-060E | ○         | 6                         | 50               |                           | 4                    | 7,320                    |                       |                  |                         |                          |       |
| HLRS 2020-02-080  |           | 8                         | 50               |                           | 4                    | 7,000                    |                       |                  |                         |                          |       |
| HLRS 2020-02-080E | ○         | 8                         | 50               |                           | 4                    | 7,700                    |                       |                  |                         |                          |       |
| HLRS 2020-02-100  |           | 10                        | 50               |                           | 4                    | 7,000                    |                       |                  |                         |                          |       |
| HLRS 2020-02-100E | ○         | 10                        | 50               |                           | 4                    | 7,700                    |                       |                  |                         |                          |       |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |       |       |                 |                 |      |
|-------------------|-----------|---------------------------|------------------|------------------------|-------------------------------------|-------|-------|-----------------|-----------------|------|
|                   |           |                           |                  |                        | 30°                                 | 1°    | 1°30' | 2°              | 3°              |      |
| HLRS 2015-02-040  |           | 1.5                       | RO.2             | 4                      | 4.12                                | 4.25  | 4.39  | 4.54            | 4.88            |      |
| HLRS 2015-02-060  |           |                           |                  | 6                      | 6.18                                | 6.38  | 6.59  | 6.82            | 7.33            |      |
| HLRS 2015-02-080  |           |                           |                  | 8                      | 8.24                                | 8.51  | 8.79  | 9.10            | 9.77            |      |
| HLRS 2015-02-100  |           |                           |                  | 10                     | 10.31                               | 10.64 | 10.99 | 11.37           | 12.22           |      |
| HLRS 2015-02-120  |           |                           |                  | 12                     | 12.37                               | 12.77 | 13.19 | 13.65           | 14.67           |      |
| HLRS 2015-02-160  |           |                           |                  | 16                     | 16.49                               | 17.03 | 17.60 | 18.21           | 19.56           |      |
| HLRS 2015-02-200  |           |                           |                  | 20                     | 20.62                               | 21.29 | 22.00 | 22.76           | No Interference |      |
| HLRS 2015-03-040  |           |                           |                  | RO.3                   | 4                                   | 4.12  | 4.25  | 4.39            | 4.54            | 4.87 |
| HLRS 2015-03-060  |           |                           | 6                |                        | 6.18                                | 6.38  | 6.59  | 6.81            | 7.31            |      |
| HLRS 2015-03-080  |           |                           | 8                |                        | 8.24                                | 8.51  | 8.79  | 9.09            | 9.76            |      |
| HLRS 2015-03-100  |           |                           | 10               |                        | 10.30                               | 10.64 | 10.99 | 11.37           | 12.21           |      |
| HLRS 2015-03-120  |           |                           | 12               |                        | 12.37                               | 12.77 | 13.19 | 13.64           | 14.66           |      |
| HLRS 2015-03-160  |           |                           | 16               |                        | 16.49                               | 17.02 | 17.59 | 18.20           | 19.55           |      |
| HLRS 2015-03-200  |           |                           | 20               |                        | 20.62                               | 21.28 | 21.99 | 22.75           | No Interference |      |
| HLRS 2015-05-040  |           |                           | RO.5             |                        | 4                                   | 4.11  | 4.24  | 4.38            | 4.52            | 4.85 |
| HLRS 2015-05-060  |           |                           |                  | 6                      | 6.18                                | 6.37  | 6.58  | 6.80            | 7.29            |      |
| HLRS 2015-05-080  |           |                           |                  | 8                      | 8.24                                | 8.50  | 8.78  | 9.08            | 9.74            |      |
| HLRS 2015-05-100  |           |                           |                  | 10                     | 10.30                               | 10.63 | 10.98 | 11.35           | 12.19           |      |
| HLRS 2015-05-120  |           |                           |                  | 12                     | 12.36                               | 12.76 | 13.18 | 13.63           | 14.64           |      |
| HLRS 2015-05-160  |           |                           |                  | 16                     | 16.49                               | 17.02 | 17.58 | 18.19           | 19.53           |      |
| HLRS 2015-05-200  |           | 20                        |                  | 20.62                  | 21.28                               | 21.98 | 22.74 | 24.42           |                 |      |
| HLRS 2020-005-040 |           | 2                         |                  | RO.05                  | 4                                   | 4.16  | 4.29  | 4.44            | 4.59            | 4.94 |
| HLRS 2020-005-060 |           |                           | 6                |                        | 6.22                                | 6.42  | 6.64  | 6.87            | 7.38            |      |
| HLRS 2020-005-080 |           |                           | 8                |                        | 8.28                                | 8.55  | 8.84  | 9.15            | 9.83            |      |
| HLRS 2020-005-100 |           |                           | 10               |                        | 10.35                               | 10.68 | 11.04 | 11.42           | 12.28           |      |
| HLRS 2020-01-040  |           |                           | RO.1             | 4                      | 4.16                                | 4.29  | 4.43  | 4.59            | 4.93            |      |
| HLRS 2020-01-040E | ○         |                           |                  | 4                      | 4.16                                | 4.29  | 4.43  | 4.59            | 4.93            |      |
| HLRS 2020-01-060  |           |                           |                  | 6                      | 6.22                                | 6.42  | 6.64  | 6.87            | 7.38            |      |
| HLRS 2020-01-060E | ○         |                           |                  | 6                      | 6.22                                | 6.42  | 6.64  | 6.87            | 7.38            |      |
| HLRS 2020-01-080  |           |                           |                  | 8                      | 8.28                                | 8.55  | 8.84  | 9.14            | 9.83            |      |
| HLRS 2020-01-080E | ○         |                           |                  | 8                      | 8.28                                | 8.55  | 8.84  | 9.14            | 9.83            |      |
| HLRS 2020-01-100  |           |                           |                  | 10                     | 10.34                               | 10.68 | 11.04 | 11.42           | 12.27           |      |
| HLRS 2020-01-100E | ○         |                           |                  | 10                     | 10.34                               | 10.68 | 11.04 | 11.42           | 12.27           |      |
| HLRS 2020-01-120  |           |                           |                  | 12                     | 12.41                               | 12.81 | 13.24 | 13.70           | 14.72           |      |
| HLRS 2020-01-120E | ○         |                           |                  | 12                     | 12.41                               | 12.81 | 13.24 | 13.70           | 14.72           |      |
| HLRS 2020-01-160  |           |                           |                  | 16                     | 16.53                               | 17.07 | 17.64 | 18.25           | No Interference |      |
| HLRS 2020-01-200  |           |                           |                  | 20                     | 20.66                               | 21.33 | 22.04 | 22.81           | No Interference |      |
| HLRS 2020-01-260  |           |                           |                  | 26                     | 26.85                               | 27.72 | 28.65 | No Interference | No Interference |      |
| HLRS 2020-01-300  |           |                           |                  | 30                     | 30.97                               | 31.98 | 33.05 | No Interference | No Interference |      |
| HLRS 2020-02-040  |           |                           |                  | RO.2                   | 4                                   | 4.15  | 4.29  | 4.43            | 4.58            | 4.92 |
| HLRS 2020-02-040E | ○         |                           |                  |                        | 4                                   | 4.15  | 4.29  | 4.43            | 4.58            | 4.92 |
| HLRS 2020-02-060  |           | 6                         | 6.22             |                        | 6.42                                | 6.63  | 6.86  | 7.37            |                 |      |
| HLRS 2020-02-060E | ○         | 6                         | 6.22             |                        | 6.42                                | 6.63  | 6.86  | 7.37            |                 |      |
| HLRS 2020-02-080  |           | 8                         | 8.28             |                        | 8.55                                | 8.83  | 9.14  | 9.82            |                 |      |
| HLRS 2020-02-080E | ○         | 8                         | 8.28             |                        | 8.55                                | 8.83  | 9.14  | 9.82            |                 |      |
| HLRS 2020-02-100  |           | 10                        | 10.34            |                        | 10.68                               | 11.03 | 11.41 | 12.26           |                 |      |
| HLRS 2020-02-100E | ○         | 10                        | 10.34            |                        | 10.68                               | 11.03 | 11.41 | 12.26           |                 |      |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |       |
|-------------------|-----------|---------------------------|------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------|
| HLRS 2020-02-120  |           | 2                         | RO.2             | 12                     | 2                 | 1.92                     | 16°                   | 55               | 4                       | 7,000                    |       |
| HLRS 2020-02-120E | ○         |                           |                  | 12                     |                   |                          |                       | 55               | 4                       | 7,700                    |       |
| HLRS 2020-02-160  |           |                           |                  | 16                     |                   |                          |                       | 60               | 4                       | 7,000                    |       |
| HLRS 2020-02-200  |           |                           |                  | 20                     |                   |                          |                       | 60               | 4                       | 7,000                    |       |
| HLRS 2020-02-260  |           |                           |                  | 26                     |                   |                          |                       | 70               | 4                       | 7,000                    |       |
| HLRS 2020-02-300  |           |                           |                  | 30                     |                   |                          |                       | 70               | 4                       | 7,000                    |       |
| HLRS 2020-03-040  |           |                           | RO.3             | 4                      |                   |                          |                       | 50               | 4                       | 6,650                    |       |
| HLRS 2020-03-040E | ○         |                           |                  | 4                      |                   |                          |                       | 50               | 4                       | 7,320                    |       |
| HLRS 2020-03-060  |           |                           |                  | 6                      |                   |                          |                       | 50               | 4                       | 6,650                    |       |
| HLRS 2020-03-060E | ○         |                           |                  | 6                      |                   |                          |                       | 50               | 4                       | 7,320                    |       |
| HLRS 2020-03-080  |           |                           |                  | 8                      |                   |                          |                       | 50               | 4                       | 7,000                    |       |
| HLRS 2020-03-080E | ○         |                           |                  | 8                      |                   |                          |                       | 50               | 4                       | 7,700                    |       |
| HLRS 2020-03-100  |           |                           |                  | 10                     |                   |                          |                       | 50               | 4                       | 7,000                    |       |
| HLRS 2020-03-100E | ○         |                           |                  | 10                     |                   |                          |                       | 50               | 4                       | 7,700                    |       |
| HLRS 2020-03-120  |           |                           |                  | 12                     |                   |                          |                       | 55               | 4                       | 7,000                    |       |
| HLRS 2020-03-120E | ○         |                           |                  | 12                     |                   |                          |                       | 55               | 4                       | 7,700                    |       |
| HLRS 2020-03-160  |           |                           |                  | 16                     |                   |                          |                       | 60               | 4                       | 7,000                    |       |
| HLRS 2020-03-200  |           |                           |                  | 20                     |                   |                          |                       | 60               | 4                       | 7,000                    |       |
| HLRS 2020-03-260  |           |                           |                  | 26                     |                   |                          |                       | 70               | 4                       | 7,000                    |       |
| HLRS 2020-03-300  |           |                           |                  | 30                     |                   |                          |                       | 70               | 4                       | 7,000                    |       |
| HLRS 2020-05-040  |           |                           |                  | RO.5                   |                   |                          |                       | 4                | 50                      | 4                        | 6,650 |
| HLRS 2020-05-040E | ○         |                           |                  |                        |                   |                          |                       | 4                | 50                      | 4                        | 7,320 |
| HLRS 2020-05-060  |           |                           |                  |                        |                   |                          |                       | 6                | 50                      | 4                        | 6,650 |
| HLRS 2020-05-060E | ○         |                           |                  |                        |                   |                          |                       | 6                | 50                      | 4                        | 7,320 |
| HLRS 2020-05-080  |           |                           | 8                |                        |                   |                          |                       | 50               | 4                       | 7,000                    |       |
| HLRS 2020-05-080E | ○         |                           | 8                |                        |                   |                          |                       | 50               | 4                       | 7,700                    |       |
| HLRS 2020-05-100  |           |                           | 10               |                        |                   |                          |                       | 50               | 4                       | 7,000                    |       |
| HLRS 2020-05-100E | ○         |                           | 10               |                        |                   |                          |                       | 50               | 4                       | 7,700                    |       |
| HLRS 2020-05-120  |           |                           | 12               |                        |                   |                          |                       | 55               | 4                       | 7,000                    |       |
| HLRS 2020-05-120E | ○         |                           | 12               |                        |                   |                          |                       | 55               | 4                       | 7,700                    |       |
| HLRS 2020-05-160  |           | 16                        | 60               |                        | 4                 | 7,000                    |                       |                  |                         |                          |       |
| HLRS 2020-05-200  |           | 20                        | 60               |                        | 4                 | 7,000                    |                       |                  |                         |                          |       |
| HLRS 2020-05-260  |           | 26                        | 70               |                        | 4                 | 7,000                    |                       |                  |                         |                          |       |
| HLRS 2020-05-300  |           | 30                        | 70               |                        | 4                 | 7,000                    |                       |                  |                         |                          |       |
| HLRS 2025-01-100  |           | 2.5                       | RO.1             | 10                     | 2.5               | 2.42                     | 16°                   | 50               | 4                       | 7,340                    |       |
| HLRS 2025-01-200  |           |                           |                  | 20                     |                   |                          |                       | 60               | 4                       | 7,570                    |       |
| HLRS 2025-01-300  |           |                           |                  | 30                     |                   |                          |                       | 70               | 4                       | 7,800                    |       |
| HLRS 2025-02-100  |           |                           | RO.2             | 10                     |                   |                          |                       | 50               | 4                       | 7,340                    |       |
| HLRS 2025-02-200  |           |                           |                  | 20                     |                   |                          |                       | 60               | 4                       | 7,570                    |       |
| HLRS 2025-02-300  |           |                           |                  | 30                     |                   |                          |                       | 70               | 4                       | 7,800                    |       |
| HLRS 2025-03-100  |           |                           | RO.3             | 10                     |                   |                          |                       | 50               | 4                       | 7,340                    |       |
| HLRS 2025-03-200  |           |                           |                  | 20                     |                   |                          |                       | 60               | 4                       | 7,570                    |       |
| HLRS 2025-03-300  |           |                           |                  | 30                     |                   |                          |                       | 70               | 4                       | 7,800                    |       |
| HLRS 2025-05-100  |           |                           | RO.5             | 10                     |                   |                          |                       | 50               | 4                       | 7,340                    |       |
| HLRS 2025-05-200  |           |                           |                  | 20                     |                   |                          |                       | 60               | 4                       | 7,570                    |       |
| HLRS 2025-05-300  |           |                           |                  | 30                     |                   |                          |                       | 70               | 4                       | 7,800                    |       |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |       |                 |                 |                 |
|-------------------|-----------|---------------------------|------------------|------------------------|-------------------------------------|-------|-----------------|-----------------|-----------------|
|                   |           |                           |                  |                        | 30°                                 | 1°    | 1°30'           | 2°              | 3°              |
| HLRS 2020-02-120  |           | 2                         | RO.2             | 12                     | 12.40                               | 12.81 | 13.23           | 13.69           | 14.71           |
| HLRS 2020-02-120E | ○         |                           |                  | 12                     | 12.40                               | 12.81 | 13.23           | 13.69           | 14.71           |
| HLRS 2020-02-160  |           |                           |                  | 16                     | 16.53                               | 17.06 | 17.64           | 18.25           | No Interference |
| HLRS 2020-02-200  |           |                           |                  | 20                     | 20.66                               | 21.32 | 22.04           | 22.80           | No Interference |
| HLRS 2020-02-260  |           |                           |                  | 26                     | 26.84                               | 27.71 | 28.64           | No Interference | No Interference |
| HLRS 2020-02-300  |           |                           |                  | 30                     | 30.97                               | 31.97 | 33.04           | No Interference | No Interference |
| HLRS 2020-03-040  |           |                           | RO.3             | 4                      | 4.15                                | 4.28  | 4.42            | 4.57            | 4.91            |
| HLRS 2020-03-040E | ○         |                           |                  | 4                      | 4.15                                | 4.28  | 4.42            | 4.57            | 4.91            |
| HLRS 2020-03-060  |           |                           |                  | 6                      | 6.21                                | 6.41  | 6.63            | 6.85            | 7.36            |
| HLRS 2020-03-060E | ○         |                           |                  | 6                      | 6.21                                | 6.41  | 6.63            | 6.85            | 7.36            |
| HLRS 2020-03-080  |           |                           |                  | 8                      | 8.28                                | 8.54  | 8.83            | 9.13            | 9.80            |
| HLRS 2020-03-080E | ○         |                           |                  | 8                      | 8.28                                | 8.54  | 8.83            | 9.13            | 9.80            |
| HLRS 2020-03-100  |           |                           |                  | 10                     | 10.34                               | 10.67 | 11.03           | 11.41           | 12.25           |
| HLRS 2020-03-100E | ○         |                           |                  | 10                     | 10.34                               | 10.67 | 11.03           | 11.41           | 12.25           |
| HLRS 2020-03-120  |           |                           |                  | 12                     | 12.40                               | 12.80 | 13.23           | 13.68           | 14.70           |
| HLRS 2020-03-120E | ○         |                           |                  | 12                     | 12.40                               | 12.80 | 13.23           | 13.68           | 14.70           |
| HLRS 2020-03-160  |           |                           |                  | 16                     | 16.53                               | 17.06 | 17.63           | 18.24           | 19.59           |
| HLRS 2020-03-200  |           |                           |                  | 20                     | 20.65                               | 21.32 | 22.03           | 22.79           | No Interference |
| HLRS 2020-03-260  |           |                           |                  | 26                     | 26.84                               | 27.71 | 28.64           | No Interference | No Interference |
| HLRS 2020-03-300  |           |                           |                  | 30                     | 30.97                               | 31.97 | 33.04           | No Interference | No Interference |
| HLRS 2020-05-040  |           |                           | RO.5             | 4                      | 4.15                                | 4.28  | 4.41            | 4.56            | 4.89            |
| HLRS 2020-05-040E | ○         |                           |                  | 4                      | 4.15                                | 4.28  | 4.41            | 4.56            | 4.89            |
| HLRS 2020-05-060  |           |                           |                  | 6                      | 6.21                                | 6.41  | 6.62            | 6.84            | 7.34            |
| HLRS 2020-05-060E | ○         |                           |                  | 6                      | 6.21                                | 6.41  | 6.62            | 6.84            | 7.34            |
| HLRS 2020-05-080  |           |                           |                  | 8                      | 8.27                                | 8.54  | 8.82            | 9.12            | 9.78            |
| HLRS 2020-05-080E | ○         |                           |                  | 8                      | 8.27                                | 8.54  | 8.82            | 9.12            | 9.78            |
| HLRS 2020-05-100  |           |                           |                  | 10                     | 10.34                               | 10.67 | 11.02           | 11.39           | 12.23           |
| HLRS 2020-05-100E | ○         |                           |                  | 10                     | 10.34                               | 10.67 | 11.02           | 11.39           | 12.23           |
| HLRS 2020-05-120  |           |                           |                  | 12                     | 12.40                               | 12.80 | 13.22           | 13.67           | 14.68           |
| HLRS 2020-05-120E | ○         |                           |                  | 12                     | 12.40                               | 12.80 | 13.22           | 13.67           | 14.68           |
| HLRS 2020-05-160  |           | 16                        |                  | 16.53                  | 17.06                               | 17.62 | 18.23           | 19.57           |                 |
| HLRS 2020-05-200  |           | 20                        |                  | 20.65                  | 21.31                               | 22.02 | 22.78           | No Interference |                 |
| HLRS 2020-05-260  |           | 26                        |                  | 26.84                  | 27.70                               | 28.63 | No Interference | No Interference |                 |
| HLRS 2020-05-300  |           | 30                        |                  | 30.97                  | 31.96                               | 33.03 | No Interference | No Interference |                 |
| HLRS 2025-01-100  |           | 2.5                       | RO.1             | 10                     | 10.34                               | 10.68 | 11.04           | 11.42           | 12.27           |
| HLRS 2025-01-200  |           |                           |                  | 20                     | 20.66                               | 21.33 | 22.04           | No Interference | No Interference |
| HLRS 2025-01-300  |           |                           |                  | 30                     | 30.97                               | 31.98 | No Interference | No Interference | No Interference |
| HLRS 2025-02-100  |           |                           | RO.2             | 10                     | 10.34                               | 10.68 | 11.03           | 11.41           | 12.26           |
| HLRS 2025-02-200  |           |                           |                  | 20                     | 20.66                               | 21.32 | 22.04           | No Interference | No Interference |
| HLRS 2025-02-300  |           |                           |                  | 30                     | 30.97                               | 31.97 | No Interference | No Interference | No Interference |
| HLRS 2025-03-100  |           |                           | RO.3             | 10                     | 10.34                               | 10.67 | 11.03           | 11.41           | 12.25           |
| HLRS 2025-03-200  |           |                           |                  | 20                     | 20.65                               | 21.32 | 22.03           | No Interference | No Interference |
| HLRS 2025-03-300  |           |                           |                  | 30                     | 30.97                               | 31.97 | No Interference | No Interference | No Interference |
| HLRS 2025-05-100  |           |                           | RO.5             | 10                     | 10.34                               | 10.67 | 11.02           | 11.39           | 12.23           |
| HLRS 2025-05-200  |           |                           |                  | 20                     | 20.65                               | 21.31 | 22.02           | No Interference | No Interference |
| HLRS 2025-05-300  |           |                           |                  | 30                     | 30.97                               | 31.96 | No Interference | No Interference | No Interference |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Unit (mm)

| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |       |
|-------------------|-----------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------|
| HLRS 2030-01-060  |           | 3                         | RO.1             | 6                         | 3                    | 2.92                     | 16°                   | 55               | 6                       | 6,000                    |       |
| HLRS 2030-01-060E | ○         |                           |                  | 6                         |                      |                          |                       | 55               | 6                       | 6,600                    |       |
| HLRS 2030-01-120  |           |                           |                  | 12                        |                      |                          |                       | 55               | 6                       | 7,800                    |       |
| HLRS 2030-01-160  |           |                           |                  | 16                        |                      |                          |                       | 60               | 6                       | 9,100                    |       |
| HLRS 2030-01-160E | ○         |                           |                  | 16                        |                      |                          |                       | 60               | 6                       | 10,010                   |       |
| HLRS 2030-01-180  |           |                           |                  | 18                        |                      |                          |                       | 60               | 6                       | 9,100                    |       |
| HLRS 2030-01-200  |           |                           |                  | 20                        |                      |                          |                       | 60               | 6                       | 9,100                    |       |
| HLRS 2030-01-260  |           |                           |                  | 26                        |                      |                          |                       | 70               | 6                       | 9,100                    |       |
| HLRS 2030-01-300  |           |                           |                  | 30                        |                      |                          |                       | 70               | 6                       | 9,100                    |       |
| HLRS 2030-01-360  |           |                           |                  | 36                        |                      |                          |                       | 80               | 6                       | 11,200                   |       |
| HLRS 2030-02-060  |           |                           |                  | RO.2                      |                      |                          |                       | 6                | 55                      | 6                        | 6,000 |
| HLRS 2030-02-060E | ○         |                           |                  |                           |                      |                          |                       | 6                | 55                      | 6                        | 6,600 |
| HLRS 2030-02-120  |           |                           | 12               |                           |                      |                          |                       | 55               | 6                       | 7,800                    |       |
| HLRS 2030-02-160  |           |                           | 16               |                           |                      |                          |                       | 60               | 6                       | 9,100                    |       |
| HLRS 2030-02-160E | ○         |                           | 16               |                           |                      |                          |                       | 60               | 6                       | 10,010                   |       |
| HLRS 2030-02-180  |           |                           | 18               |                           |                      |                          |                       | 60               | 6                       | 9,100                    |       |
| HLRS 2030-02-200  |           |                           | 20               |                           |                      |                          |                       | 60               | 6                       | 9,100                    |       |
| HLRS 2030-02-260  |           |                           | 26               |                           |                      |                          |                       | 70               | 6                       | 9,100                    |       |
| HLRS 2030-02-300  |           |                           | 30               |                           |                      |                          |                       | 70               | 6                       | 9,100                    |       |
| HLRS 2030-02-360  |           |                           | 36               |                           |                      |                          |                       | 80               | 6                       | 11,200                   |       |
| HLRS 2030-03-060  |           |                           | RO.3             |                           |                      |                          |                       | 6                | 55                      | 6                        | 6,000 |
| HLRS 2030-03-060E | ○         |                           |                  |                           |                      |                          |                       | 6                | 55                      | 6                        | 6,600 |
| HLRS 2030-03-120  |           |                           |                  | 12                        |                      |                          |                       | 55               | 6                       | 7,800                    |       |
| HLRS 2030-03-160  |           |                           |                  | 16                        |                      |                          |                       | 60               | 6                       | 9,100                    |       |
| HLRS 2030-03-160E | ○         |                           |                  | 16                        |                      |                          |                       | 60               | 6                       | 10,010                   |       |
| HLRS 2030-03-180  |           |                           |                  | 18                        |                      |                          |                       | 60               | 6                       | 9,100                    |       |
| HLRS 2030-03-200  |           |                           |                  | 20                        |                      |                          |                       | 60               | 6                       | 9,100                    |       |
| HLRS 2030-03-260  |           |                           |                  | 26                        |                      |                          |                       | 70               | 6                       | 9,100                    |       |
| HLRS 2030-03-300  |           |                           |                  | 30                        |                      |                          |                       | 70               | 6                       | 9,100                    |       |
| HLRS 2030-03-360  |           |                           |                  | 36                        |                      |                          |                       | 80               | 6                       | 11,200                   |       |
| HLRS 2030-05-060  |           |                           |                  | RO.5                      |                      |                          |                       | 6                | 55                      | 6                        | 6,000 |
| HLRS 2030-05-060E | ○         |                           |                  |                           |                      |                          |                       | 6                | 55                      | 6                        | 6,600 |
| HLRS 2030-05-120  |           |                           | 12               |                           |                      |                          |                       | 55               | 6                       | 7,800                    |       |
| HLRS 2030-05-160  |           |                           | 16               |                           |                      |                          |                       | 60               | 6                       | 9,100                    |       |
| HLRS 2030-05-160E | ○         |                           | 16               |                           |                      |                          |                       | 60               | 6                       | 10,010                   |       |
| HLRS 2030-05-180  |           |                           | 18               |                           |                      |                          |                       | 60               | 6                       | 9,100                    |       |
| HLRS 2030-05-200  |           | 20                        | 60               |                           | 6                    | 9,100                    |                       |                  |                         |                          |       |
| HLRS 2030-05-260  |           | 26                        | 70               |                           | 6                    | 9,100                    |                       |                  |                         |                          |       |
| HLRS 2030-05-300  |           | 30                        | 70               |                           | 6                    | 9,100                    |                       |                  |                         |                          |       |
| HLRS 2030-05-360  |           | 36                        | 80               |                           | 6                    | 11,200                   |                       |                  |                         |                          |       |

- $\phi 3\text{mm}$  Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |       |       |                 |                 |      |
|-------------------|-----------|---------------------------|------------------|------------------------|-------------------------------------|-------|-------|-----------------|-----------------|------|
|                   |           |                           |                  |                        | 30°                                 | 1°    | 1°30' | 2°              | 3°              |      |
| HLRS 2030-01-060  |           | 3                         | RO.1             | 6                      | 6.21                                | 6.42  | 6.63  | 6.86            | 7.37            |      |
| HLRS 2030-01-060E | ○         |                           |                  | 6                      | 6.21                                | 6.42  | 6.63  | 6.86            | 7.37            |      |
| HLRS 2030-01-120  |           |                           |                  | 12                     | 12.40                               | 12.81 | 13.23 | 13.69           | 14.72           |      |
| HLRS 2030-01-160  |           |                           |                  | 16                     | 16.53                               | 17.06 | 17.64 | 18.25           | 19.61           |      |
| HLRS 2030-01-160E | ○         |                           |                  | 16                     | 16.53                               | 17.06 | 17.64 | 18.25           | 19.61           |      |
| HLRS 2030-01-180  |           |                           |                  | 18                     | 18.59                               | 19.19 | 19.84 | 20.53           | 22.06           |      |
| HLRS 2030-01-200  |           |                           |                  | 20                     | 20.65                               | 21.32 | 22.04 | 22.80           | 24.51           |      |
| HLRS 2030-01-260  |           |                           |                  | 26                     | 26.84                               | 27.71 | 28.64 | 29.64           | No Interference |      |
| HLRS 2030-01-300  |           |                           |                  | 30                     | 30.97                               | 31.97 | 33.04 | 34.19           | No Interference |      |
| HLRS 2030-01-360  |           |                           |                  | 36                     | 37.16                               | 38.36 | 39.65 | 41.02           | No Interference |      |
| HLRS 2030-02-060  |           |                           |                  | RO.2                   | 6                                   | 6.21  | 6.41  | 6.63            | 6.85            | 7.36 |
| HLRS 2030-02-060E | ○         |                           |                  |                        | 6                                   | 6.21  | 6.41  | 6.63            | 6.85            | 7.36 |
| HLRS 2030-02-120  |           |                           | 12               |                        | 12.40                               | 12.80 | 13.23 | 13.69           | 14.71           |      |
| HLRS 2030-02-160  |           |                           | 16               |                        | 16.53                               | 17.06 | 17.63 | 18.24           | 19.60           |      |
| HLRS 2030-02-160E | ○         |                           | 16               |                        | 16.53                               | 17.06 | 17.63 | 18.24           | 19.60           |      |
| HLRS 2030-02-180  |           |                           | 18               |                        | 18.59                               | 19.19 | 19.83 | 20.52           | 22.05           |      |
| HLRS 2030-02-200  |           |                           | 20               |                        | 20.65                               | 21.32 | 22.03 | 22.80           | 24.49           |      |
| HLRS 2030-02-260  |           |                           | 26               |                        | 26.84                               | 27.71 | 28.64 | 29.63           | No Interference |      |
| HLRS 2030-02-300  |           |                           | 30               |                        | 30.97                               | 31.97 | 33.04 | 34.18           | No Interference |      |
| HLRS 2030-02-360  |           |                           | 36               |                        | 37.15                               | 38.36 | 39.64 | 41.02           | No Interference |      |
| HLRS 2030-03-060  |           |                           | RO.3             |                        | 6                                   | 6.21  | 6.41  | 6.62            | 6.85            | 7.35 |
| HLRS 2030-03-060E | ○         |                           |                  |                        | 6                                   | 6.21  | 6.41  | 6.62            | 6.85            | 7.35 |
| HLRS 2030-03-120  |           |                           |                  | 12                     | 12.40                               | 12.80 | 13.22 | 13.68           | 14.70           |      |
| HLRS 2030-03-160  |           |                           |                  | 16                     | 16.53                               | 17.06 | 17.63 | 18.23           | 19.59           |      |
| HLRS 2030-03-160E | ○         |                           |                  | 16                     | 16.53                               | 17.06 | 17.63 | 18.23           | 19.59           |      |
| HLRS 2030-03-180  |           |                           |                  | 18                     | 18.59                               | 19.19 | 19.83 | 20.51           | 22.04           |      |
| HLRS 2030-03-200  |           |                           |                  | 20                     | 20.65                               | 21.32 | 22.03 | 22.79           | 24.48           |      |
| HLRS 2030-03-260  |           |                           |                  | 26                     | 26.84                               | 27.71 | 28.63 | 29.62           | No Interference |      |
| HLRS 2030-03-300  |           |                           |                  | 30                     | 30.96                               | 31.97 | 33.03 | 34.18           | No Interference |      |
| HLRS 2030-03-360  |           |                           |                  | 36                     | 37.15                               | 38.35 | 39.64 | 41.01           | No Interference |      |
| HLRS 2030-05-060  |           |                           |                  | RO.5                   | 6                                   | 6.21  | 6.40  | 6.61            | 6.83            | 7.33 |
| HLRS 2030-05-060E | ○         |                           |                  |                        | 6                                   | 6.21  | 6.40  | 6.61            | 6.83            | 7.33 |
| HLRS 2030-05-120  |           |                           | 12               |                        | 12.40                               | 12.79 | 13.21 | 13.67           | 14.67           |      |
| HLRS 2030-05-160  |           |                           | 16               |                        | 16.52                               | 17.05 | 17.62 | 18.22           | 19.57           |      |
| HLRS 2030-05-160E | ○         |                           | 16               |                        | 16.52                               | 17.05 | 17.62 | 18.22           | 19.57           |      |
| HLRS 2030-05-180  |           |                           | 18               |                        | 18.58                               | 19.18 | 19.82 | 20.50           | 22.02           |      |
| HLRS 2030-05-200  |           | 20                        | 20.65            |                        | 21.31                               | 22.02 | 22.78 | 24.46           |                 |      |
| HLRS 2030-05-260  |           | 26                        | 26.84            |                        | 27.70                               | 28.62 | 29.61 | No Interference |                 |      |
| HLRS 2030-05-300  |           | 30                        | 30.96            |                        | 31.96                               | 33.02 | 34.16 | No Interference |                 |      |
| HLRS 2030-05-360  |           | 36                        | 37.15            |                        | 38.35                               | 39.63 | 41.00 | No Interference |                 |      |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Unit (mm)

| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |      |
|-------------------|-----------|---------------------------|------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|------|
| HLRS 2030-10-060  |           | 3                         | R1               | 6                      | 3                 | 2.92                     | 16°                   | 55               | 6                       | 6,000                    |      |
| HLRS 2030-10-060E | ○         |                           |                  | 6                      |                   |                          |                       | 6,600            |                         |                          |      |
| HLRS 2030-10-120  |           |                           |                  | 12                     |                   |                          |                       | 7,800            |                         |                          |      |
| HLRS 2030-10-160  |           |                           |                  | 16                     |                   |                          |                       | 9,100            |                         |                          |      |
| HLRS 2030-10-160E | ○         |                           |                  | 16                     |                   |                          |                       | 10,010           |                         |                          |      |
| HLRS 2030-10-180  |           |                           |                  | 18                     |                   |                          |                       | 9,100            |                         |                          |      |
| HLRS 2030-10-200  |           |                           |                  | 20                     |                   |                          |                       | 9,100            |                         |                          |      |
| HLRS 2030-10-260  |           |                           |                  | 26                     |                   |                          |                       | 9,100            |                         |                          |      |
| HLRS 2030-10-300  |           |                           |                  | 30                     |                   |                          |                       | 9,100            |                         |                          |      |
| HLRS 2030-10-360  |           |                           |                  | 36                     |                   |                          |                       | 11,200           |                         |                          |      |
| HLRS 2040-01-080  |           |                           |                  | 4                      |                   |                          |                       | RO.1             | 8                       | 4                        | 3.82 |
| HLRS 2040-01-080E | ○         | 8                         | 8,580            |                        |                   |                          |                       |                  |                         |                          |      |
| HLRS 2040-01-120  |           | 12                        | 8,000            |                        |                   |                          |                       |                  |                         |                          |      |
| HLRS 2040-01-160  |           | 16                        | 9,400            |                        |                   |                          |                       |                  |                         |                          |      |
| HLRS 2040-01-200  |           | 20                        | 10,130           |                        |                   |                          |                       |                  |                         |                          |      |
| HLRS 2040-01-200E | ○         | 20                        | 11,140           |                        |                   |                          |                       |                  |                         |                          |      |
| HLRS 2040-01-240  |           | 24                        | 10,130           |                        |                   |                          |                       |                  |                         |                          |      |
| HLRS 2040-01-320  |           | 32                        | 10,130           |                        |                   |                          |                       |                  |                         |                          |      |
| HLRS 2040-01-480  |           | 48                        | 16,200           |                        |                   |                          |                       |                  |                         |                          |      |
| HLRS 2040-02-080  |           | RO.2                      | 8                |                        | 65                | 6                        | 7,800                 |                  |                         |                          |      |
| HLRS 2040-02-080E | ○         |                           | 8                |                        | 65                | 6                        | 8,580                 |                  |                         |                          |      |
| HLRS 2040-02-120  |           |                           | 12               |                        | 65                | 6                        | 8,000                 |                  |                         |                          |      |
| HLRS 2040-02-160  |           |                           | 16               |                        | 65                | 6                        | 9,400                 |                  |                         |                          |      |
| HLRS 2040-02-200  |           |                           | 20               |                        | 65                | 6                        | 10,130                |                  |                         |                          |      |
| HLRS 2040-02-200E | ○         |                           | 20               |                        | 65                | 6                        | 11,140                |                  |                         |                          |      |
| HLRS 2040-02-240  |           |                           | 24               |                        | 70                | 6                        | 10,130                |                  |                         |                          |      |
| HLRS 2040-02-320  |           |                           | 32               |                        | 80                | 6                        | 10,130                |                  |                         |                          |      |
| HLRS 2040-02-480  |           |                           | 48               |                        | 100               | 6                        | 16,200                |                  |                         |                          |      |
| HLRS 2040-03-080  |           |                           | RO.3             |                        | 8                 | 65                       | 6                     | 7,800            |                         |                          |      |
| HLRS 2040-03-080E | ○         |                           |                  |                        | 8                 | 65                       | 6                     | 8,580            |                         |                          |      |
| HLRS 2040-03-120  |           |                           |                  |                        | 12                | 65                       | 6                     | 8,000            |                         |                          |      |
| HLRS 2040-03-160  |           |                           |                  |                        | 16                | 65                       | 6                     | 9,400            |                         |                          |      |
| HLRS 2040-03-200  |           |                           |                  |                        | 20                | 65                       | 6                     | 10,130           |                         |                          |      |
| HLRS 2040-03-200E | ○         | 20                        |                  |                        | 65                | 6                        | 11,140                |                  |                         |                          |      |
| HLRS 2040-03-240  |           | 24                        |                  |                        | 70                | 6                        | 10,130                |                  |                         |                          |      |
| HLRS 2040-03-320  |           | 32                        |                  |                        | 80                | 6                        | 10,130                |                  |                         |                          |      |
| HLRS 2040-03-480  |           | 48                        |                  |                        | 100               | 6                        | 16,200                |                  |                         |                          |      |
| HLRS 2040-05-080  |           | RO.5                      |                  |                        | 8                 | 65                       | 6                     | 7,800            |                         |                          |      |
| HLRS 2040-05-080E | ○         |                           |                  | 8                      | 65                | 6                        | 8,580                 |                  |                         |                          |      |
| HLRS 2040-05-120  |           |                           |                  | 12                     | 65                | 6                        | 8,000                 |                  |                         |                          |      |
| HLRS 2040-05-160  |           |                           |                  | 16                     | 65                | 6                        | 9,400                 |                  |                         |                          |      |
| HLRS 2040-05-200  |           |                           |                  | 20                     | 65                | 6                        | 10,130                |                  |                         |                          |      |
| HLRS 2040-05-200E | ○         |                           | 20               | 65                     | 6                 | 11,140                   |                       |                  |                         |                          |      |
| HLRS 2040-05-240  |           |                           | 24               | 70                     | 6                 | 10,130                   |                       |                  |                         |                          |      |
| HLRS 2040-05-320  |           |                           | 32               | 80                     | 6                 | 10,130                   |                       |                  |                         |                          |      |
| HLRS 2040-05-480  |           |                           | 48               | 100                    | 6                 | 16,200                   |                       |                  |                         |                          |      |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|-------------------|-----------|---------------------------|------------------|------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|                   |           |                           |                  |                        | 30°                                 | 1°              | 1°30'           | 2°              | 3°              |
| HLRS 2030-10-060  |           | 3                         | R1               | 6                      | 6.20                                | 6.39            | 6.59            | 6.80            | 7.28            |
| HLRS 2030-10-060E | ○         |                           |                  | 6                      | 6.20                                | 6.39            | 6.59            | 6.80            | 7.28            |
| HLRS 2030-10-120  |           |                           |                  | 12                     | 12.39                               | 12.78           | 13.19           | 13.63           | 14.62           |
| HLRS 2030-10-160  |           |                           |                  | 16                     | 16.51                               | 17.04           | 17.59           | 18.19           | 19.52           |
| HLRS 2030-10-160E | ○         |                           |                  | 16                     | 16.51                               | 17.04           | 17.59           | 18.19           | 19.52           |
| HLRS 2030-10-180  |           |                           |                  | 18                     | 18.58                               | 19.17           | 19.79           | 20.47           | 21.96           |
| HLRS 2030-10-200  |           |                           |                  | 20                     | 20.64                               | 21.29           | 21.99           | 22.74           | 24.41           |
| HLRS 2030-10-260  |           |                           |                  | 26                     | 26.83                               | 27.68           | 28.60           | 29.57           | No Interference |
| HLRS 2030-10-300  |           |                           |                  | 30                     | 30.95                               | 31.94           | 33.00           | 34.13           | No Interference |
| HLRS 2030-10-360  |           |                           |                  | 36                     | 37.14                               | 38.33           | 39.60           | 40.96           | No Interference |
| HLRS 2040-01-080  |           |                           |                  | 4                      | RO.1                                | 8               | 8.45            | 8.73            | 9.02            |
| HLRS 2040-01-080E | ○         | 8                         | 8.45             |                        |                                     | 8.73            | 9.02            | 9.33            | 10.03           |
| HLRS 2040-01-120  |           | 12                        | 12.58            |                        |                                     | 12.99           | 13.42           | 13.89           | 14.92           |
| HLRS 2040-01-160  |           | 16                        | 16.70            |                        |                                     | 17.25           | 17.82           | 18.44           | No Interference |
| HLRS 2040-01-200  |           | 20                        | 20.83            |                        |                                     | 21.50           | 22.23           | 23.00           | No Interference |
| HLRS 2040-01-200E | ○         | 20                        | 20.83            |                        |                                     | 21.50           | 22.23           | 23.00           | No Interference |
| HLRS 2040-01-240  |           | 24                        | 24.95            |                        |                                     | 25.76           | 26.63           | 27.55           | No Interference |
| HLRS 2040-01-320  |           | 32                        | 33.21            |                        |                                     | 34.28           | 35.43           | No Interference | No Interference |
| HLRS 2040-01-480  |           | 48                        | 49.71            |                        | 51.32                               | No Interference | No Interference | No Interference |                 |
| HLRS 2040-02-080  |           | RO.2                      | 8                |                        | 8.45                                | 8.72            | 9.01            | 9.33            | 10.02           |
| HLRS 2040-02-080E | ○         |                           | 8                |                        | 8.45                                | 8.72            | 9.01            | 9.33            | 10.02           |
| HLRS 2040-02-120  |           |                           | 12               |                        | 12.58                               | 12.98           | 13.42           | 13.88           | 14.91           |
| HLRS 2040-02-160  |           |                           | 16               |                        | 16.70                               | 17.24           | 17.82           | 18.44           | No Interference |
| HLRS 2040-02-200  |           |                           | 20               |                        | 20.83                               | 21.50           | 22.22           | 22.99           | No Interference |
| HLRS 2040-02-200E | ○         |                           | 20               |                        | 20.83                               | 21.50           | 22.22           | 22.99           | No Interference |
| HLRS 2040-02-240  |           |                           | 24               |                        | 24.95                               | 25.76           | 26.62           | 27.54           | No Interference |
| HLRS 2040-02-320  |           |                           | 32               |                        | 33.20                               | 34.28           | 35.43           | No Interference | No Interference |
| HLRS 2040-02-480  |           | 48                        | 49.71            |                        | 51.32                               | No Interference | No Interference | No Interference |                 |
| HLRS 2040-03-080  |           | RO.3                      | 8                |                        | 8.45                                | 8.72            | 9.01            | 9.32            | 10.01           |
| HLRS 2040-03-080E | ○         |                           | 8                |                        | 8.45                                | 8.72            | 9.01            | 9.32            | 10.01           |
| HLRS 2040-03-120  |           |                           | 12               |                        | 12.58                               | 12.98           | 13.41           | 13.87           | 14.69           |
| HLRS 2040-03-160  |           |                           | 16               |                        | 16.70                               | 17.24           | 17.81           | 18.43           | No Interference |
| HLRS 2040-03-200  |           |                           | 20               |                        | 20.83                               | 21.50           | 22.22           | 22.98           | No Interference |
| HLRS 2040-03-200E | ○         |                           | 20               |                        | 20.83                               | 21.50           | 22.22           | 22.98           | No Interference |
| HLRS 2040-03-240  |           |                           | 24               |                        | 24.95                               | 25.76           | 26.62           | 27.54           | No Interference |
| HLRS 2040-03-320  |           |                           | 32               |                        | 33.20                               | 34.28           | 35.42           | No Interference | No Interference |
| HLRS 2040-03-480  |           |                           | 48               |                        | 49.71                               | 51.31           | No Interference | No Interference | No Interference |
| HLRS 2040-05-080  |           |                           | RO.5             |                        | 8                                   | 8.45            | 8.71            | 9.00            | 9.31            |
| HLRS 2040-05-080E | ○         | 8                         |                  | 8.45                   | 8.71                                | 9.00            | 9.31            | 9.99            |                 |
| HLRS 2040-05-120  |           | 12                        |                  | 12.57                  | 12.97                               | 13.40           | 13.86           | 14.88           |                 |
| HLRS 2040-05-160  |           | 16                        |                  | 16.70                  | 17.23                               | 17.80           | 18.42           | No Interference |                 |
| HLRS 2040-05-200  |           | 20                        |                  | 20.82                  | 21.49                               | 22.21           | 22.97           | No Interference |                 |
| HLRS 2040-05-200E | ○         | 20                        |                  | 20.82                  | 21.49                               | 22.21           | 22.97           | No Interference |                 |
| HLRS 2040-05-240  |           | 24                        |                  | 24.95                  | 25.75                               | 26.61           | 27.52           | No Interference |                 |
| HLRS 2040-05-320  |           | 32                        |                  | 33.20                  | 34.27                               | 35.41           | No Interference | No Interference |                 |
| HLRS 2040-05-480  |           | 48                        | 49.70            | 51.31                  | No Interference                     | No Interference | No Interference |                 |                 |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Square  
Long Neck  
Square

Radius  
Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball / Long  
Shank Ball  
Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |      |     |    |        |
|-------------------|-----------|---------------------------|------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|------|-----|----|--------|
| HLRS 2040-10-080  |           | 4                         | R1               | 8                      | 4                 | 3.82                     | 16°                   | 65               | 6                       | 7,800                    |      |     |    |        |
| HLRS 2040-10-080E | ○         |                           |                  | 8                      |                   |                          |                       | 8,580            |                         |                          |      |     |    |        |
| HLRS 2040-10-120  |           |                           |                  | 12                     |                   |                          |                       | 8,000            |                         |                          |      |     |    |        |
| HLRS 2040-10-160  |           |                           |                  | 16                     |                   |                          |                       | 9,400            |                         |                          |      |     |    |        |
| HLRS 2040-10-200  |           |                           |                  | 20                     |                   |                          |                       | 10,130           |                         |                          |      |     |    |        |
| HLRS 2040-10-200E | ○         |                           |                  | 20                     |                   |                          |                       | 11,140           |                         |                          |      |     |    |        |
| HLRS 2040-10-240  |           |                           |                  | 24                     |                   |                          |                       | 10,130           |                         |                          |      |     |    |        |
| HLRS 2040-10-320  |           |                           |                  | 32                     |                   |                          |                       | 10,130           |                         |                          |      |     |    |        |
| HLRS 2040-10-480  |           |                           |                  | 48                     |                   |                          |                       | 16,200           |                         |                          |      |     |    |        |
| HLRS 2050-02-200  |           |                           |                  | 5                      |                   |                          |                       | RO.2             | 20                      | 5                        | 4.82 | 16° | 70 | 6      |
| HLRS 2050-02-400  |           | 40                        | 16,200           |                        |                   |                          |                       |                  |                         |                          |      |     |    |        |
| HLRS 2050-03-200  |           | RO.3                      | 20               |                        | 70                | 6                        | 12,900                |                  |                         |                          |      |     |    |        |
| HLRS 2050-03-400  |           |                           | 40               |                        | 90                | 6                        | 16,200                |                  |                         |                          |      |     |    |        |
| HLRS 2050-05-200  |           | RO.5                      | 20               |                        | 70                | 6                        | 12,900                |                  |                         |                          |      |     |    |        |
| HLRS 2050-05-400  |           |                           | 40               |                        | 90                | 6                        | 16,200                |                  |                         |                          |      |     |    |        |
| HLRS 2050-10-200  |           | R1                        | 20               |                        | 70                | 6                        | 12,900                |                  |                         |                          |      |     |    |        |
| HLRS 2050-10-400  |           |                           | 40               |                        | 90                | 6                        | 16,200                |                  |                         |                          |      |     |    |        |
| HLRS 2060-01-120  |           | 6                         | RO.1             |                        | 12                | 6                        | 5.82                  | -                | 65                      |                          |      |     | 6  | 12,900 |
| HLRS 2060-01-120E | ○         |                           |                  |                        | 12                |                          |                       |                  | 65                      |                          |      |     | 6  | 14,190 |
| HLRS 2060-01-200  |           |                           |                  | 20                     | 70                |                          |                       |                  | 6                       | 12,900                   |      |     |    |        |
| HLRS 2060-01-300  |           |                           |                  | 30                     | 100               |                          |                       |                  | 6                       | 16,700                   |      |     |    |        |
| HLRS 2060-01-300E | ○         |                           |                  | 30                     | 100               |                          |                       |                  | 6                       | 18,370                   |      |     |    |        |
| HLRS 2060-01-600  |           |                           |                  | 60                     | 120               |                          |                       |                  | 6                       | 20,300                   |      |     |    |        |
| HLRS 2060-02-120  |           |                           | RO.2             | 12                     | 65                |                          |                       |                  | 6                       | 12,900                   |      |     |    |        |
| HLRS 2060-02-120E | ○         |                           |                  | 12                     | 65                |                          |                       |                  | 6                       | 14,190                   |      |     |    |        |
| HLRS 2060-02-200  |           |                           |                  | 20                     | 70                |                          |                       |                  | 6                       | 12,900                   |      |     |    |        |
| HLRS 2060-02-300  |           |                           |                  | 30                     | 100               |                          |                       |                  | 6                       | 16,700                   |      |     |    |        |
| HLRS 2060-02-300E | ○         |                           | 30               | 100                    | 6                 |                          |                       |                  | 18,370                  |                          |      |     |    |        |
| HLRS 2060-02-600  |           |                           | 60               | 120                    | 6                 |                          |                       |                  | 20,300                  |                          |      |     |    |        |
| HLRS 2060-03-120  |           |                           | RO.3             | 12                     | 65                |                          |                       |                  | 6                       | 12,900                   |      |     |    |        |
| HLRS 2060-03-120E | ○         |                           |                  | 12                     | 65                |                          |                       |                  | 6                       | 14,190                   |      |     |    |        |
| HLRS 2060-03-200  |           |                           |                  | 20                     | 70                |                          |                       |                  | 6                       | 12,900                   |      |     |    |        |
| HLRS 2060-03-300  |           |                           |                  | 30                     | 100               |                          |                       |                  | 6                       | 16,700                   |      |     |    |        |
| HLRS 2060-03-300E | ○         |                           |                  | 30                     | 100               |                          |                       |                  | 6                       | 18,370                   |      |     |    |        |
| HLRS 2060-03-600  |           |                           |                  | 60                     | 120               |                          |                       |                  | 6                       | 20,300                   |      |     |    |        |
| HLRS 2060-05-120  |           |                           | RO.5             | 12                     | 65                |                          |                       |                  | 6                       | 12,900                   |      |     |    |        |
| HLRS 2060-05-120E | ○         |                           |                  | 12                     | 65                |                          |                       |                  | 6                       | 14,190                   |      |     |    |        |
| HLRS 2060-05-200  |           | 20                        |                  | 70                     | 6                 | 12,900                   |                       |                  |                         |                          |      |     |    |        |
| HLRS 2060-05-300  |           | 30                        |                  | 100                    | 6                 | 16,700                   |                       |                  |                         |                          |      |     |    |        |
| HLRS 2060-05-300E | ○         | 30                        |                  | 100                    | 6                 | 18,370                   |                       |                  |                         |                          |      |     |    |        |
| HLRS 2060-05-600  |           | 60                        |                  | 120                    | 6                 | 20,300                   |                       |                  |                         |                          |      |     |    |        |
| HLRS 2060-10-120  |           | R1                        | 12               | 65                     | 6                 | 12,900                   |                       |                  |                         |                          |      |     |    |        |
| HLRS 2060-10-120E | ○         |                           | 12               | 65                     | 6                 | 14,190                   |                       |                  |                         |                          |      |     |    |        |
| HLRS 2060-10-200  |           |                           | 20               | 70                     | 6                 | 12,900                   |                       |                  |                         |                          |      |     |    |        |
| HLRS 2060-10-300  |           |                           | 30               | 100                    | 6                 | 16,700                   |                       |                  |                         |                          |      |     |    |        |
| HLRS 2060-10-300E | ○         |                           | 30               | 100                    | 6                 | 18,370                   |                       |                  |                         |                          |      |     |    |        |
| HLRS 2060-10-600  |           |                           | 60               | 120                    | 6                 | 20,300                   |                       |                  |                         |                          |      |     |    |        |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| Model Number      | Excellent | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |                 |                 |                 |                 |                 |
|-------------------|-----------|---------------------------|------------------|------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                   |           |                           |                  |                        | 30°                                 | 1°              | 1'30"           | 2°              | 3°              |                 |
| HLRS 2040-10-080  |           | 4                         | R1               | 8                      | 8.44                                | 8.70            | 8.98            | 9.27            | 9.93            |                 |
| HLRS 2040-10-080E | ○         |                           |                  | 8                      | 8.44                                | 8.70            | 8.98            | 9.27            | 9.93            |                 |
| HLRS 2040-10-120  |           |                           |                  | 12                     | 12.56                               | 12.96           | 13.38           | 13.83           | 14.83           |                 |
| HLRS 2040-10-160  |           |                           |                  | 16                     | 16.69                               | 17.22           | 17.78           | 18.38           | 19.72           |                 |
| HLRS 2040-10-200  |           |                           |                  | 20                     | 20.82                               | 21.48           | 22.18           | 22.94           | No Interference |                 |
| HLRS 2040-10-200E | ○         |                           |                  | 20                     | 20.82                               | 21.48           | 22.18           | 22.94           | No Interference |                 |
| HLRS 2040-10-240  |           |                           |                  | 24                     | 24.94                               | 25.74           | 26.58           | 27.49           | No Interference |                 |
| HLRS 2040-10-320  |           |                           |                  | 32                     | 33.19                               | 34.25           | 35.39           | No Interference | No Interference |                 |
| HLRS 2040-10-480  |           |                           |                  | 48                     | 49.69                               | 51.29           | No Interference | No Interference | No Interference |                 |
| HLRS 2050-02-200  |           |                           |                  | 5                      | R0.2                                | 20              | 20.83           | 21.50           | No Interference | No Interference |
| HLRS 2050-02-400  |           | 40                        | 41.46            |                        |                                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2050-03-200  |           | R0.3                      | 20               |                        | 20.83                               | 21.50           | No Interference | No Interference | No Interference |                 |
| HLRS 2050-03-400  |           |                           | 40               |                        | 41.45                               | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2050-05-200  |           | R0.5                      | 20               |                        | 20.82                               | 21.49           | No Interference | No Interference | No Interference |                 |
| HLRS 2050-05-400  |           |                           | 40               |                        | 41.45                               | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2050-10-200  |           | R1                        | 20               |                        | 20.82                               | 21.48           | No Interference | No Interference | No Interference |                 |
| HLRS 2050-10-400  |           |                           | 40               |                        | 41.44                               | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-01-120  |           | 6                         | R0.1             |                        | 12                                  | No Interference | No Interference | No Interference | No Interference | No Interference |
| HLRS 2060-01-120E | ○         |                           |                  |                        | 12                                  | No Interference | No Interference | No Interference | No Interference | No Interference |
| HLRS 2060-01-200  |           |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-01-300  |           |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-01-300E | ○         |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-01-600  |           |                           |                  | 60                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-02-120  |           |                           | R0.2             | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-02-120E | ○         |                           |                  | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-02-200  |           |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-02-300  |           |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-02-300E | ○         |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-02-600  |           |                           |                  | 60                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-03-120  |           |                           | R0.3             | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-03-120E | ○         |                           |                  | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-03-200  |           |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-03-300  |           |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-03-300E | ○         |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-03-600  |           |                           |                  | 60                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-05-120  |           |                           | R0.5             | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-05-120E | ○         |                           |                  | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-05-200  |           |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-05-300  |           |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-05-300E | ○         |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-05-600  |           |                           |                  | 60                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-10-120  |           |                           | R1               | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-10-120E | ○         |                           |                  | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-10-200  |           |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-10-300  |           |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-10-300E | ○         |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 2060-10-600  |           |                           |                  | 60                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |

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Milling Conditions for HLRS (2 Flutes)

| WORK MATERIAL |                       |                       | Copper<br>OFC / TPC                |                    |                                 |                                  | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD (30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKH<br>(55~65HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2002          | 0.2                   | 0.5                   | 55,000                             | 230                | 0.027                           | 0.02                             | 55,000  | 230                | 0.006                           | 0.02                             | 44,800                                     | 236                | 0.005                           | 0.02                             | 19,000                                     | 30                 | 0.002                           | 0.015                            |
|               |                       | 1                     | 55,000                             | 200                | 0.027                           | 0.02                             | 55,000  | 200                | 0.006                           | 0.02                             | 35,000                                     | 150                | 0.004                           | 0.02                             | 15,000                                     | 25                 | 0.0015                          | 0.015                            |
|               |                       | 1.5                   | 55,000                             | 180                | 0.017                           | 0.01                             | 55,000  | 180                | 0.005                           | 0.01                             | 27,000                                     | 100                | 0.003                           | 0.01                             | 12,000                                     | 20                 | 0.001                           | 0.007                            |
|               |                       | 2                     | 55,000                             | 170                | 0.007                           | 0.005                            | 55,000  | 170                | 0.003                           | 0.005                            | 20,000                                     | 60                 | 0.002                           | 0.005                            | 10,500                                     | 15                 | 0.001                           | 0.003                            |
| 2003          | 0.3                   | 1                     | 60,000                             | 500                | 0.03                            | 0.02                             | 60,000  | 500                | 0.007                           | 0.02                             | 35,000                                     | 350                | 0.005                           | 0.02                             | 22,000                                     | 35                 | 0.004                           | 0.015                            |
|               |                       | 1.5                   | 60,000                             | 470                | 0.03                            | 0.02                             | 60,000  | 470                | 0.007                           | 0.02                             | 35,000                                     | 310                | 0.005                           | 0.018                            | 22,000                                     | 33                 | 0.004                           | 0.015                            |
|               |                       | 2                     | 60,000                             | 400                | 0.03                            | 0.02                             | 60,000  | 400                | 0.007                           | 0.02                             | 33,200                                     | 250                | 0.005                           | 0.015                            | 20,000                                     | 32                 | 0.004                           | 0.015                            |
|               |                       | 2.5                   | 57,000                             | 330                | 0.03                            | 0.017                            | 57,000  | 330                | 0.007                           | 0.017                            | 30,000                                     | 180                | 0.003                           | 0.012                            | 18,000                                     | 30                 | 0.002                           | 0.012                            |
|               |                       | 3                     | 52,000                             | 220                | 0.03                            | 0.015                            | 52,000  | 220                | 0.006                           | 0.015                            | 25,000                                     | 80                 | 0.003                           | 0.01                             | 15,000                                     | 20                 | 0.002                           | 0.01                             |
| 2004          | 0.4                   | 1                     | 50,900                             | 610                | 0.048                           | 0.063                            | 50,900  | 510                | 0.013                           | 0.072                            | 40,700                                     | 370                | 0.011                           | 0.072                            | 24,200                                     | 40                 | 0.004                           | 0.072                            |
|               |                       | 1.5                   | 45,200                             | 580                | 0.045                           | 0.063                            | 45,200  | 480                | 0.012                           | 0.054                            | 36,200                                     | 360                | 0.01                            | 0.054                            | 21,500                                     | 38                 | 0.004                           | 0.054                            |
|               |                       | 2                     | 40,400                             | 540                | 0.042                           | 0.054                            | 40,400  | 450                | 0.011                           | 0.045                            | 32,300                                     | 330                | 0.009                           | 0.045                            | 19,200                                     | 35                 | 0.004                           | 0.045                            |
|               |                       | 3                     | 33,900                             | 460                | 0.027                           | 0.054                            | 33,900  | 390                | 0.008                           | 0.027                            | 27,100                                     | 280                | 0.007                           | 0.027                            | 16,100                                     | 30                 | 0.003                           | 0.027                            |
|               |                       | 4                     | 30,000                             | 220                | 0.01                            | 0.045                            | 30,000  | 340                | 0.006                           | 0.014                            | 24,000                                     | 250                | 0.005                           | 0.014                            | 14,300                                     | 27                 | 0.002                           | 0.014                            |
| 2005          | 0.5                   | 1                     | 49,200                             | 1,370              | 0.081                           | 0.117                            | 49,200  | 1,140              | 0.034                           | 0.122                            | 40,000                                     | 860                | 0.03                            | 0.122                            | 24,800                                     | 94                 | 0.013                           | 0.122                            |
|               |                       | 2                     | 39,900                             | 1,000              | 0.075                           | 0.108                            | 39,900  | 830                | 0.029                           | 0.117                            | 32,500                                     | 630                | 0.026                           | 0.117                            | 20,100                                     | 68                 | 0.011                           | 0.117                            |
|               |                       | 3                     | 31,900                             | 770                | 0.057                           | 0.09                             | 31,900  | 640                | 0.023                           | 0.113                            | 26,000                                     | 480                | 0.02                            | 0.113                            | 16,100                                     | 52                 | 0.008                           | 0.113                            |
|               |                       | 4                     | 29,100                             | 660                | 0.039                           | 0.072                            | 29,100  | 550                | 0.016                           | 0.108                            | 23,700                                     | 410                | 0.014                           | 0.108                            | 14,600                                     | 45                 | 0.006                           | 0.108                            |
|               |                       | 5                     | 26,400                             | 570                | 0.027                           | 0.045                            | 26,400  | 470                | 0.011                           | 0.099                            | 21,500                                     | 360                | 0.01                            | 0.099                            | 13,300                                     | 39                 | 0.004                           | 0.099                            |
|               |                       | 6                     | 24,200                             | 480                | 0.021                           | 0.018                            | 24,200  | 400                | 0.007                           | 0.09                             | 19,700                                     | 300                | 0.006                           | 0.09                             | 12,200                                     | 33                 | 0.003                           | 0.09                             |
| 2006          | 0.6                   | 2                     | 28,600                             | 610                | 0.114                           | 0.162                            | 28,600  | 510                | 0.01                            | 0.219                            | 23,700                                     | 390                | 0.01                            | 0.219                            | 15,200                                     | 43                 | 0.004                           | 0.219                            |
|               |                       | 3                     | 23,800                             | 480                | 0.09                            | 0.135                            | 23,800  | 400                | 0.008                           | 0.108                            | 19,700                                     | 300                | 0.007                           | 0.108                            | 12,600                                     | 33                 | 0.003                           | 0.108                            |
|               |                       | 4                     | 20,400                             | 400                | 0.063                           | 0.108                            | 20,400  | 330                | 0.005                           | 0.104                            | 16,800                                     | 250                | 0.005                           | 0.104                            | 10,800                                     | 28                 | 0.002                           | 0.104                            |
|               |                       | 6                     | 16,800                             | 300                | 0.036                           | 0.045                            | 16,800  | 250                | 0.003                           | 0.099                            | 13,900                                     | 190                | 0.003                           | 0.099                            | 8,900                                      | 21                 | 0.001                           | 0.099                            |
|               |                       | 8                     | 14,600                             | 240                | 0.021                           | 0.027                            | 14,600  | 200                | 0.002                           | 0.072                            | 12,100                                     | 150                | 0.002                           | 0.072                            | 7,700                                      | 16                 | 0.001                           | 0.072                            |
| 2007          | 0.7                   | 4                     | 18,400                             | 480                | 0.087                           | 0.162                            | 18,400  | 400                | 0.008                           | 0.117                            | 15,500                                     | 310                | 0.008                           | 0.117                            | 10,200                                     | 35                 | 0.004                           | 0.117                            |
|               |                       | 6                     | 15,400                             | 360                | 0.051                           | 0.108                            | 15,400  | 300                | 0.005                           | 0.108                            | 13,000                                     | 230                | 0.005                           | 0.108                            | 8,600                                      | 26                 | 0.002                           | 0.108                            |
| 2008          | 0.8                   | 4                     | 17,500                             | 540                | 0.132                           | 0.198                            | 17,500  | 450                | 0.014                           | 0.117                            | 15,000                                     | 360                | 0.015                           | 0.117                            | 10,200                                     | 41                 | 0.007                           | 0.117                            |
|               |                       | 6                     | 14,600                             | 410                | 0.075                           | 0.144                            | 14,600  | 340                | 0.008                           | 0.108                            | 12,500                                     | 270                | 0.008                           | 0.108                            | 8,500                                      | 30                 | 0.004                           | 0.108                            |
|               |                       | 8                     | 12,800                             | 310                | 0.03                            | 0.1                              | 12,800  | 270                | 0.005                           | 0.09                             | 11,000                                     | 185                | 0.004                           | 0.09                             | 7,600                                      | 20                 | 0.002                           | 0.09                             |
| 2010          | 1                     | 2                     | 17,600                             | 1,100              | 0.21                            | 0.45                             | 17,600  | 920                | 0.035                           | 0.27                             | 15,300                                     | 750                | 0.04                            | 0.27                             | 10,900                                     | 89                 | 0.02                            | 0.27                             |
|               |                       | 3                     | 15,500                             | 1,050              | 0.205                           | 0.425                            | 15,500  | 870                | 0.031                           | 0.27                             | 13,200                                     | 720                | 0.037                           | 0.27                             | 9,400                                      | 86                 | 0.018                           | 0.27                             |
|               |                       | 4                     | 13,800                             | 980                | 0.201                           | 0.405                            | 13,800  | 820                | 0.03                            | 0.27                             | 12,000                                     | 670                | 0.035                           | 0.27                             | 8,500                                      | 80                 | 0.017                           | 0.27                             |
|               |                       | 5                     | 12,500                             | 900                | 0.16                            | 0.4                              | 12,500  | 720                | 0.025                           | 0.24                             | 11,000                                     | 600                | 0.03                            | 0.24                             | 7,800                                      | 72                 | 0.015                           | 0.24                             |
|               |                       | 6                     | 11,300                             | 790                | 0.117                           | 0.387                            | 11,300  | 650                | 0.021                           | 0.216                            | 9,800                                      | 540                | 0.024                           | 0.216                            | 7,000                                      | 64                 | 0.012                           | 0.216                            |
|               |                       | 8                     | 9,800                              | 590                | 0.072                           | 0.36                             | 9,800   | 490                | 0.016                           | 0.189                            | 8,500                                      | 400                | 0.018                           | 0.189                            | 6,100                                      | 48                 | 0.009                           | 0.189                            |
|               |                       | 10                    | 8,800                              | 390                | 0.048                           | 0.315                            | 8,800   | 320                | 0.011                           | 0.126                            | 7,600                                      | 270                | 0.013                           | 0.126                            | 5,400                                      | 32                 | 0.006                           | 0.126                            |
|               |                       | 12                    | 8,100                              | 260                | 0.033                           | 0.27                             | 8,100   | 210                | 0.008                           | 0.072                            | 7,000                                      | 180                | 0.009                           | 0.072                            | 5,000                                      | 21                 | 0.004                           | 0.072                            |
|               |                       | 16                    | 7,000                              | 230                | 0.018                           | 0.225                            | 7,000   | 190                | 0.004                           | 0.027                            | 6,100                                      | 160                | 0.005                           | 0.027                            | 4,300                                      | 19                 | 0.002                           | 0.027                            |
|               |                       | 20                    | 6,300                              | 160                | 0.015                           | 0.18                             | 6,300   | 130                | 0.003                           | 0.018                            | 5,500                                      | 110                | 0.003                           | 0.018                            | 3,900                                      | 13                 | 0.001                           | 0.018                            |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



## Milling Conditions for HLRS (2 Flutes)

| WORK MATERIAL |                       |                       | Copper<br>OFC / TPC                |                    |                                 |                                  | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD (30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKH<br>(55~65HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2012          | 1.2                   | 6                     | 9,400                              | 700                | 0.186                           | 0.468                            | 9,400   | 580                | 0.018                           | 0.09                             | 8,400                                      | 490                | 0.022                           | 0.09                             | 6,200                                      | 60                 | 0.011                           | 0.09                             |
|               |                       | 12                    | 6,800                              | 440                | 0.054                           | 0.405                            | 6,800   | 370                | 0.007                           | 0.072                            | 6,100                                      | 310                | 0.008                           | 0.072                            | 4,500                                      | 38                 | 0.004                           | 0.072                            |
|               |                       | 20                    | 5,400                              | 250                | 0.021                           | 0.24                             | 5,400   | 210                | 0.003                           | 0.018                            | 4,800                                      | 180                | 0.003                           | 0.018                            | 3,500                                      | 22                 | 0.002                           | 0.018                            |
| 2015          | 1.5                   | 4                     | 13,200                             | 1,310              | 0.3                             | 0.675                            | 13,200  | 1,090              | 0.045                           | 0.45                             | 12,000                                     | 950                | 0.06                            | 0.45                             | 9,200                                      | 124                | 0.033                           | 0.45                             |
|               |                       | 6                     | 10,600                             | 1,240              | 0.282                           | 0.63                             | 10,600  | 1,030              | 0.041                           | 0.405                            | 9,700                                      | 900                | 0.055                           | 0.405                            | 7,400                                      | 117                | 0.03                            | 0.405                            |
|               |                       | 8                     | 9,300                              | 1,050              | 0.204                           | 0.612                            | 9,300   | 870                | 0.034                           | 0.315                            | 8,500                                      | 760                | 0.045                           | 0.315                            | 6,500                                      | 99                 | 0.025                           | 0.315                            |
|               |                       | 10                    | 8,500                              | 900                | 0.15                            | 0.567                            | 8,500   | 750                | 0.032                           | 0.288                            | 7,800                                      | 650                | 0.042                           | 0.288                            | 6,000                                      | 85                 | 0.023                           | 0.288                            |
|               |                       | 12                    | 7,800                              | 800                | 0.114                           | 0.54                             | 7,800   | 670                | 0.029                           | 0.27                             | 7,100                                      | 580                | 0.038                           | 0.27                             | 5,400                                      | 76                 | 0.021                           | 0.27                             |
|               |                       | 16                    | 6,800                              | 620                | 0.066                           | 0.45                             | 6,800   | 510                | 0.015                           | 0.18                             | 6,200                                      | 450                | 0.02                            | 0.18                             | 4,700                                      | 58                 | 0.011                           | 0.18                             |
|               |                       | 20                    | 6,000                              | 490                | 0.042                           | 0.36                             | 6,000   | 410                | 0.005                           | 0.108                            | 5,500                                      | 360                | 0.006                           | 0.108                            | 4,200                                      | 46                 | 0.003                           | 0.108                            |
| 2020          | 2                     | 4                     | 15,300                             | 1,500              | 0.33                            | 0.9                              | 15,300  | 1,250              | 0.046                           | 0.9                              | 14,300                                     | 1,130              | 0.065                           | 0.9                              | 11,500                                     | 162                | 0.039                           | 0.9                              |
|               |                       | 6                     | 12,800                             | 1,220              | 0.321                           | 0.855                            | 12,800  | 1,020              | 0.043                           | 0.81                             | 12,000                                     | 930                | 0.06                            | 0.81                             | 9,700                                      | 133                | 0.036                           | 0.81                             |
|               |                       | 8                     | 11,200                             | 1,120              | 0.267                           | 0.81                             | 11,200  | 930                | 0.039                           | 0.72                             | 10,400                                     | 850                | 0.055                           | 0.72                             | 8,400                                      | 121                | 0.033                           | 0.72                             |
|               |                       | 10                    | 10,000                             | 1,050              | 0.225                           | 0.765                            | 10,000  | 870                | 0.033                           | 0.585                            | 9,300                                      | 790                | 0.047                           | 0.585                            | 7,600                                      | 113                | 0.028                           | 0.585                            |
|               |                       | 12                    | 9,100                              | 980                | 0.186                           | 0.72                             | 9,100   | 820                | 0.031                           | 0.45                             | 8,500                                      | 740                | 0.044                           | 0.45                             | 6,900                                      | 107                | 0.026                           | 0.45                             |
|               |                       | 16                    | 7,800                              | 830                | 0.132                           | 0.702                            | 7,800   | 690                | 0.028                           | 0.315                            | 7,300                                      | 630                | 0.039                           | 0.315                            | 5,900                                      | 90                 | 0.023                           | 0.315                            |
|               |                       | 20                    | 7,000                              | 770                | 0.093                           | 0.666                            | 7,000   | 640                | 0.017                           | 0.198                            | 6,600                                      | 580                | 0.024                           | 0.198                            | 5,300                                      | 84                 | 0.014                           | 0.198                            |
|               |                       | 26                    | 6,200                              | 700                | 0.06                            | 0.54                             | 6,200   | 580                | 0.006                           | 0.144                            | 5,800                                      | 530                | 0.008                           | 0.144                            | 4,600                                      | 75                 | 0.005                           | 0.144                            |
|               |                       | 30                    | 6,000                              | 670                | 0.05                            | 0.45                             | 6,000   | 550                | 0.005                           | 0.135                            | 5,500                                      | 500                | 0.005                           | 0.135                            | 4,400                                      | 70                 | 0.002                           | 0.135                            |
| 2025          | 2.5                   | 10                    | 10,500                             | 1,220              | 0.339                           | 0.855                            | 10,500  | 1,020              | 0.052                           | 0.54                             | 10,000                                     | 960                | 0.075                           | 0.54                             | 8,400                                      | 154                | 0.048                           | 0.54                             |
|               |                       | 20                    | 7,800                              | 720                | 0.165                           | 0.756                            | 7,800   | 600                | 0.024                           | 0.225                            | 7,500                                      | 560                | 0.035                           | 0.225                            | 6,300                                      | 91                 | 0.022                           | 0.225                            |
|               |                       | 30                    | 6,300                              | 540                | 0.069                           | 0.63                             | 6,300   | 450                | 0.011                           | 0.18                             | 6,000                                      | 420                | 0.016                           | 0.18                             | 5,000                                      | 67                 | 0.01                            | 0.18                             |
| 2030          | 3                     | 6                     | 14,000                             | 2,700              | 0.5                             | 0.9                              | 14,000  | 1,510              | 0.15                            | 0.72                             | 13,300                                     | 1,140              | 0.15                            | 0.72                             | 12,000                                     | 270                | 0.1                             | 0.72                             |
|               |                       | 12                    | 10,500                             | 1,600              | 0.39                            | 0.85                             | 10,500  | 1,150              | 0.105                           | 0.67                             | 10,000                                     | 890                | 0.105                           | 0.67                             | 9,000                                      | 200                | 0.075                           | 0.67                             |
|               |                       | 16                    | 9,200                              | 1,160              | 0.321                           | 0.81                             | 9,200   | 960                | 0.081                           | 0.63                             | 8,800                                      | 730                | 0.081                           | 0.63                             | 7,900                                      | 173                | 0.054                           | 0.63                             |
|               |                       | 18                    | 8,800                              | 1,100              | 0.29                            | 0.79                             | 8,800   | 900                | 0.078                           | 0.6                              | 8,300                                      | 700                | 0.078                           | 0.6                              | 7,500                                      | 160                | 0.048                           | 0.6                              |
|               |                       | 20                    | 8,400                              | 1,050              | 0.26                            | 0.78                             | 8,400   | 880                | 0.073                           | 0.58                             | 7,900                                      | 680                | 0.073                           | 0.58                             | 7,100                                      | 150                | 0.044                           | 0.58                             |
|               |                       | 26                    | 7,500                              | 980                | 0.18                            | 0.72                             | 7,500   | 820                | 0.065                           | 0.495                            | 7,100                                      | 620                | 0.065                           | 0.495                            | 6,400                                      | 146                | 0.043                           | 0.495                            |
|               |                       | 30                    | 7,000                              | 870                | 0.14                            | 0.69                             | 7,000   | 720                | 0.05                            | 0.38                             | 6,500                                      | 560                | 0.05                            | 0.38                             | 6,000                                      | 118                | 0.029                           | 0.38                             |
|               |                       | 36                    | 6,400                              | 710                | 0.09                            | 0.63                             | 6,400   | 590                | 0.022                           | 0.18                             | 6,100                                      | 440                | 0.022                           | 0.18                             | 5,500                                      | 105                | 0.014                           | 0.18                             |
| 2040          | 4                     | 8                     | 10,200                             | 1,340              | 0.42                            | 1.62                             | 10,200  | 1,110              | 0.095                           | 1.35                             | 8,500                                      | 970                | 0.14                            | 1.35                             | 7,300                                      | 223                | 0.101                           | 1.35                             |
|               |                       | 12                    | 8,900                              | 1,300              | 0.41                            | 1.56                             | 8,900   | 1,080              | 0.083                           | 1.15                             | 7,600                                      | 950                | 0.12                            | 1.15                             | 6,400                                      | 215                | 0.085                           | 1.15                             |
|               |                       | 16                    | 7,900                              | 1,250              | 0.4                             | 1.5                              | 7,900   | 1,030              | 0.065                           | 1                                | 6,600                                      | 910                | 0.1                             | 1                                | 5,600                                      | 205                | 0.065                           | 1                                |
|               |                       | 20                    | 6,900                              | 1,190              | 0.384                           | 1.44                             | 6,900   | 990                | 0.054                           | 0.9                              | 5,800                                      | 860                | 0.08                            | 0.9                              | 4,900                                      | 198                | 0.058                           | 0.9                              |
|               |                       | 24                    | 6,200                              | 1,100              | 0.31                            | 1.38                             | 6,200   | 900                | 0.043                           | 0.8                              | 5,200                                      | 770                | 0.065                           | 0.8                              | 4,500                                      | 175                | 0.043                           | 0.8                              |
|               |                       | 32                    | 5,500                              | 860                | 0.189                           | 1.26                             | 5,500   | 720                | 0.027                           | 0.648                            | 4,600                                      | 630                | 0.04                            | 0.648                            | 3,900                                      | 144                | 0.029                           | 0.648                            |
|               |                       | 48                    | 4,600                              | 430                | 0.093                           | 1.08                             | 4,600   | 360                | 0.007                           | 0.315                            | 3,900                                      | 310                | 0.01                            | 0.315                            | 3,300                                      | 72                 | 0.007                           | 0.315                            |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
Radius  
Taper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
Ball  
Taper Neck  
BallTaper  
Taper

Barrel

Spiral  
V Cutter

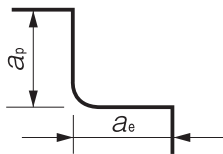
Drill

Technical Data

Milling Conditions for HLRS (2 Flutes)

| WORK MATERIAL |                       |                       | Copper<br>OFC / TPC                |                    |                        |                         | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD (30~45HRC) |                    |                        |                         | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                        |                         | HARDENED STEELS<br>SKD / SKH<br>(55~65HRC) |                    |                        |                         |
|---------------|-----------------------|-----------------------|------------------------------------|--------------------|------------------------|-------------------------|---|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                            | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2050          | 5                     | 20                    | 6,700                              | 1,780              | 0.606                  | 1.98                    | 6,700   | 1,480              | 0.092                  | 1.17                    | 4,800                                      | 990                | 0.13                   | 1.17                    | 4,000                                      | 297                | 0.096                  | 1.17                    |
|               |                       | 40                    | 4,600                              | 850                | 0.297                  | 1.53                    | 4,600   | 710                | 0.046                  | 0.9                     | 3,300                                      | 470                | 0.065                  | 0.9                     | 2,800                                      | 143                | 0.048                  | 0.9                     |
| 2060          | 6                     | 12                    | 8,000                              | 1,800              | 0.6                    | 2.25                    | 8,000   | 1,620              | 0.5                    | 1.35                    | 4,700                                      | 1,360              | 0.2                    | 1.35                    | 4,000                                      | 540                | 0.15                   | 1.35                    |
|               |                       | 20                    | 5,800                              | 1,350              | 0.58                   | 2.12                    | 5,800   | 1,180              | 0.46                   | 1.31                    | 3,500                                      | 1,000              | 0.18                   | 1.31                    | 3,000                                      | 380                | 0.14                   | 1.31                    |
|               |                       | 30                    | 4,500                              | 1,060              | 0.546                  | 1.98                    | 4,500   | 880                | 0.396                  | 1.26                    | 2,600                                      | 740                | 0.158                  | 1.26                    | 2,200                                      | 294                | 0.119                  | 1.26                    |
|               |                       | 60                    | 2,800                              | 530                | 0.156                  | 1.62                    | 2,800   | 440                | 0.113                  | 0.99                    | 1,600                                      | 370                | 0.045                  | 0.99                    | 1,400                                      | 147                | 0.034                  | 0.99                    |

Side Milling



Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Every coolant offers stable milling.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend wet coolant for Copper.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius

Long Neck  
Radius  
Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball  
Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

∅3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.2 \sim \phi 6$

# HGLRS

Super MG

HMGC  
COAT

30°

R

$\pm 0.003$

Shank Dia  
0/-0.004

Back Taper  
Geometry

Variable  
Pitch

**NEW**

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 | ○                                | ●               | ●      | ●      | ★      | ★      |           |                 |          |        |          |                       |                 |                       |                  |                                       |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

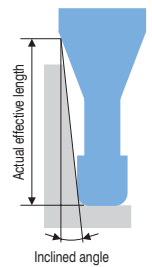
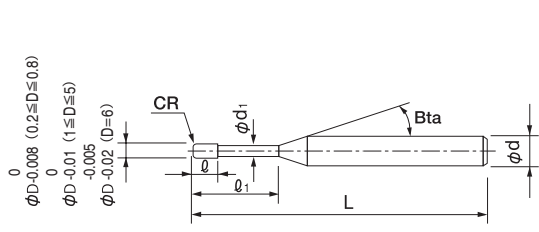
Taper Neck Ball

Barrel

Spiral V Cutter

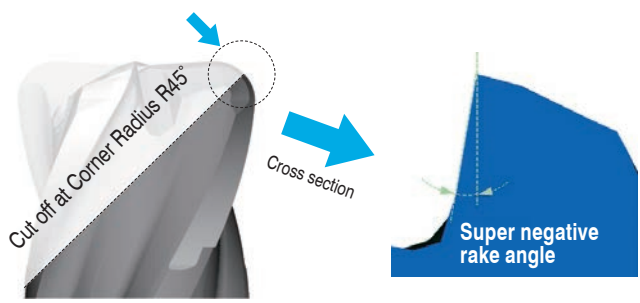
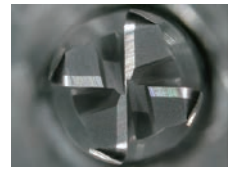
Drill

Technical Data



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

◆ **Super negative rake angle is best suited for 60-70 HRC as it greatly reduces the cutting resistance.**



◆ **High Precision Diameter Tolerance / Radius Accuracy / Shank Diameter Tolerance**

| HLRS Tolerance        |                    | Unit (mm)       |                          |
|-----------------------|--------------------|-----------------|--------------------------|
| Outside Diameter      | Diameter Tolerance | Radius Accuracy | Shank Diameter Tolerance |
| $0.2 \leq D \leq 0.6$ | 0/-0.01            | ±0.005          | 0/-0.005                 |
| $0.8 \leq D \leq 5$   | 0/-0.015           |                 |                          |
| D=6                   | -0.005/-0.02       |                 |                          |

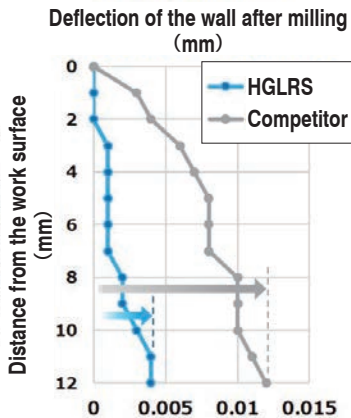
| HGLRS Tolerance       |                    | Unit (mm)       |                          |
|-----------------------|--------------------|-----------------|--------------------------|
| Outside Diameter      | Diameter Tolerance | Radius Accuracy | Shank Diameter Tolerance |
| $0.2 \leq D \leq 0.8$ | <b>0/-0.008</b>    | ±0.003          | <b>0/-0.004 (h4)</b>     |
| $1 \leq D \leq 5$     | <b>0/-0.01</b>     |                 |                          |
| D=6                   | -0.005/-0.02       |                 |                          |

## Dimensional accuracy comparison HGLRS $\phi 3 \times \text{CR0.3} \times \text{EL16}$

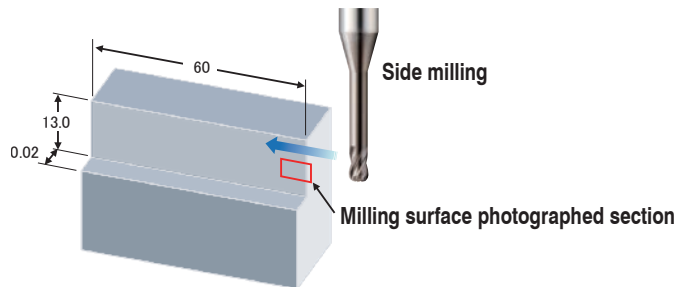
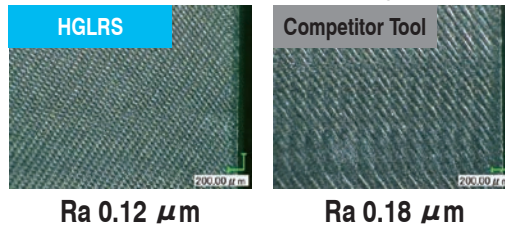
HAP72 (69HRC)

### Smaller dimensional change and better milling accuracy with HGLRS

| Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Cycle Time | Coolant  |
|------------------------------------|--------------------|------------|------------|------------|----------|
| 7,000                              | 1,800              | 0.03       | 0.02       | 15 min     | Air Blow |



#### Surface condition after milling

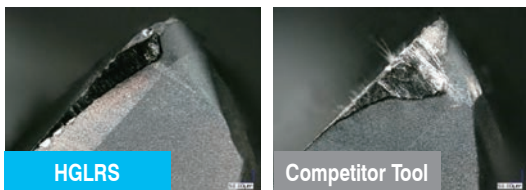


## Wear width comparison HGLRS $\phi 3 \times \text{CR0.3} \times \text{EL16}$

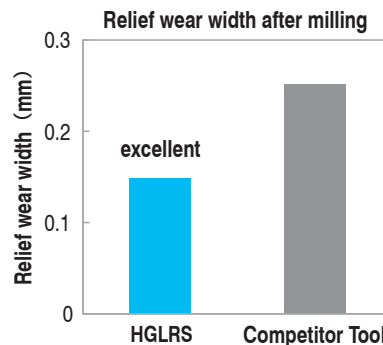
HAP72 (69HRC)

### High efficiency milling and long tool life achieved even on new generation super hard materials.

| Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Cycle Time | Coolant  |
|------------------------------------|--------------------|------------|------------|------------|----------|
| 7,000                              | 900                | 0.03       | 0.6        | 68 min     | Air Blow |



Milling shape  
Square pocket  $10 \times 10 \times 5 \text{ mm}$



4 Flutes

$\phi 3\text{mm}$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Total 184 models

Unit (mm)

| Model Number       | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|
| HGLRS 4002-002-005 | 0.2                       | RO.02            | 0.5                       | 0.12                 | 0.185                    | 16°                       | 50               | 4                       | 14,100                   |
| HGLRS 4002-002-010 |                           |                  | 1                         |                      |                          |                           | 50               | 4                       | 14,100                   |
| HGLRS 4002-002-020 |                           |                  | 2                         |                      |                          |                           | 50               | 4                       | 14,100                   |
| HGLRS 4002-005-005 |                           | RO.05            | 0.5                       |                      |                          |                           | 50               | 4                       | 14,100                   |
| HGLRS 4002-005-010 |                           |                  | 1                         |                      |                          |                           | 50               | 4                       | 14,100                   |
| HGLRS 4002-005-020 |                           |                  | 2                         |                      |                          |                           | 50               | 4                       | 14,100                   |
| HGLRS 4003-002-005 | 0.3                       | RO.02            | 0.5                       | 0.18                 | 0.285                    | 16°                       | 50               | 4                       | 14,100                   |
| HGLRS 4003-002-010 |                           |                  | 1                         |                      |                          |                           | 50               | 4                       | 14,100                   |
| HGLRS 4003-002-015 |                           |                  | 1.5                       |                      |                          |                           | 50               | 4                       | 14,100                   |
| HGLRS 4003-002-020 |                           | 2                | 50                        |                      |                          |                           | 4                | 14,100                  |                          |
| HGLRS 4003-005-005 |                           | RO.05            | 0.5                       |                      |                          |                           | 50               | 4                       | 14,100                   |
| HGLRS 4003-005-010 |                           |                  | 1                         |                      |                          |                           | 50               | 4                       | 14,100                   |
| HGLRS 4003-005-020 | 2                         |                  | 50                        | 4                    | 14,100                   |                           |                  |                         |                          |
| HGLRS 4004-002-010 | 0.4                       | RO.02            | 1                         | 0.24                 | 0.385                    | 16°                       | 50               | 4                       | 9,050                    |
| HGLRS 4004-002-020 |                           |                  | 2                         |                      |                          |                           | 50               | 4                       | 9,050                    |
| HGLRS 4004-005-010 |                           | RO.05            | 1                         |                      |                          |                           | 50               | 4                       | 9,050                    |
| HGLRS 4004-005-020 |                           |                  | 2                         |                      |                          |                           | 50               | 4                       | 9,050                    |
| HGLRS 4004-01-010  |                           | RO.1             | 1                         |                      |                          |                           | 50               | 4                       | 9,050                    |
| HGLRS 4004-01-020  |                           |                  | 2                         |                      |                          |                           | 50               | 4                       | 9,050                    |
| HGLRS 4005-002-010 | 0.5                       | RO.02            | 1                         | 0.3                  | 0.485                    | 16°                       | 50               | 4                       | 7,370                    |
| HGLRS 4005-002-020 |                           |                  | 2                         |                      |                          |                           | 50               | 4                       | 7,370                    |
| HGLRS 4005-002-030 |                           |                  | 3                         |                      |                          |                           | 50               | 4                       | 7,370                    |
| HGLRS 4005-005-010 |                           | RO.05            | 1                         |                      |                          |                           | 50               | 4                       | 7,370                    |
| HGLRS 4005-005-020 |                           |                  | 2                         |                      |                          |                           | 50               | 4                       | 7,370                    |
| HGLRS 4005-005-030 |                           |                  | 3                         |                      |                          |                           | 50               | 4                       | 7,370                    |
| HGLRS 4005-01-010  | RO.1                      | 1                | 50                        | 4                    | 7,370                    |                           |                  |                         |                          |
| HGLRS 4005-01-020  |                           | 2                | 50                        | 4                    | 7,370                    |                           |                  |                         |                          |
| HGLRS 4005-01-030  |                           | 3                | 50                        | 4                    | 7,370                    |                           |                  |                         |                          |
| HGLRS 4006-005-020 | 0.6                       | RO.05            | 2                         | 0.36                 | 0.585                    | 16°                       | 50               | 4                       | 7,370                    |
| HGLRS 4006-005-040 |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 7,370                    |
| HGLRS 4006-01-020  |                           | RO.1             | 2                         |                      |                          |                           | 50               | 4                       | 7,370                    |
| HGLRS 4006-01-040  |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 7,370                    |
| HGLRS 4008-005-020 | 0.8                       | RO.05            | 2                         | 0.48                 | 0.78                     | 16°                       | 50               | 4                       | 8,100                    |
| HGLRS 4008-005-040 |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 8,400                    |
| HGLRS 4008-005-060 |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 8,400                    |
| HGLRS 4008-01-020  |                           | RO.1             | 2                         |                      |                          |                           | 50               | 4                       | 8,100                    |
| HGLRS 4008-01-040  |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 8,400                    |
| HGLRS 4008-01-060  |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 8,400                    |
| HGLRS 4008-02-020  | RO.2                      | 2                | 50                        | 4                    | 8,100                    |                           |                  |                         |                          |
| HGLRS 4008-02-040  |                           | 4                | 50                        | 4                    | 8,400                    |                           |                  |                         |                          |
| HGLRS 4008-02-060  |                           | 6                | 50                        | 4                    | 8,400                    |                           |                  |                         |                          |
| HGLRS 4010-002-020 |                           | 1                | RO.02                     | 2                    | 0.8                      | 0.98                      | 16°              | 50                      | 4                        |
| HGLRS 4010-002-030 | 3                         |                  |                           | 50                   |                          |                           |                  | 4                       | 7,400                    |
| HGLRS 4010-002-040 | 4                         |                  |                           | 50                   |                          |                           |                  | 4                       | 7,400                    |
| HGLRS 4010-002-050 | 5                         |                  |                           | 50                   |                          |                           |                  | 4                       | 8,100                    |

- $\phi 3\text{mm}$  Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Unit (mm)

| Model Number       | Outside Diameter<br>$\phi D$ | Corner Radius<br>CR | Effective Length<br>$l_1$ | Effective Length by Inclined Angles |      |       |      |      |
|--------------------|------------------------------|---------------------|---------------------------|-------------------------------------|------|-------|------|------|
|                    |                              |                     |                           | 30°                                 | 1°   | 1°30' | 2°   | 3°   |
| HGLRS 4002-002-005 | 0.2                          | RO.02               | 0.5                       | 0.61                                | 0.64 | 0.67  | 0.70 | 0.76 |
| HGLRS 4002-002-010 |                              |                     | 1                         | 1.13                                | 1.18 | 1.23  | 1.28 | 1.38 |
| HGLRS 4002-002-020 |                              |                     | 2                         | 2.17                                | 2.25 | 2.34  | 2.43 | 2.63 |
| HGLRS 4002-005-005 |                              | RO.05               | 0.5                       | 0.60                                | 0.64 | 0.67  | 0.70 | 0.75 |
| HGLRS 4002-005-010 |                              |                     | 1                         | 1.13                                | 1.18 | 1.22  | 1.27 | 1.37 |
| HGLRS 4002-005-020 |                              |                     | 2                         | 2.17                                | 2.25 | 2.33  | 2.42 | 2.62 |
| HGLRS 4003-002-005 | 0.3                          | RO.02               | 0.5                       | 0.63                                | 0.66 | 0.69  | 0.72 | 0.78 |
| HGLRS 4003-002-010 |                              |                     | 1                         | 1.15                                | 1.20 | 1.24  | 1.29 | 1.40 |
| HGLRS 4003-002-015 |                              |                     | 1.5                       | 1.66                                | 1.72 | 1.79  | 1.85 | 2.01 |
| HGLRS 4003-002-020 |                              | 2                   | 2.18                      | 2.26                                | 2.34 | 2.43  | 2.63 |      |
| HGLRS 4003-005-005 |                              | RO.05               | 0.5                       | 0.63                                | 0.66 | 0.68  | 0.71 | 0.77 |
| HGLRS 4003-005-010 |                              |                     | 1                         | 1.15                                | 1.20 | 1.24  | 1.29 | 1.39 |
| HGLRS 4003-005-020 | 2                            |                     | 2.18                      | 2.26                                | 2.34 | 2.43  | 2.62 |      |
| HGLRS 4004-002-010 | 0.4                          | RO.02               | 1                         | 1.15                                | 1.20 | 1.24  | 1.29 | 1.40 |
| HGLRS 4004-002-020 |                              |                     | 2                         | 2.18                                | 2.26 | 2.34  | 2.43 | 2.63 |
| HGLRS 4004-005-010 |                              | RO.05               | 1                         | 1.15                                | 1.20 | 1.24  | 1.29 | 1.39 |
| HGLRS 4004-005-020 |                              |                     | 2                         | 2.18                                | 2.26 | 2.34  | 2.43 | 2.62 |
| HGLRS 4004-01-010  |                              | RO.1                | 1                         | 1.15                                | 1.19 | 1.23  | 1.28 | 1.38 |
| HGLRS 4004-01-020  |                              |                     | 2                         | 2.18                                | 2.25 | 2.33  | 2.42 | 2.61 |
| HGLRS 4005-002-010 | 0.5                          | RO.02               | 1                         | 1.15                                | 1.20 | 1.24  | 1.29 | 1.40 |
| HGLRS 4005-002-020 |                              |                     | 2                         | 2.18                                | 2.26 | 2.34  | 2.43 | 2.63 |
| HGLRS 4005-002-030 |                              |                     | 3                         | 3.21                                | 3.33 | 3.45  | 3.58 | 3.87 |
| HGLRS 4005-005-010 |                              | RO.05               | 1                         | 1.15                                | 1.20 | 1.24  | 1.29 | 1.39 |
| HGLRS 4005-005-020 |                              |                     | 2                         | 2.18                                | 2.26 | 2.34  | 2.43 | 2.62 |
| HGLRS 4005-005-030 |                              |                     | 3                         | 3.21                                | 3.33 | 3.45  | 3.58 | 3.87 |
| HGLRS 4005-01-010  |                              | RO.1                | 1                         | 1.15                                | 1.19 | 1.23  | 1.28 | 1.38 |
| HGLRS 4005-01-020  |                              |                     | 2                         | 2.18                                | 2.25 | 2.33  | 2.42 | 2.61 |
| HGLRS 4005-01-030  |                              |                     | 3                         | 3.21                                | 3.32 | 3.44  | 3.57 | 3.85 |
| HGLRS 4006-005-020 | 0.6                          | RO.05               | 2                         | 2.18                                | 2.26 | 2.34  | 2.43 | 2.62 |
| HGLRS 4006-005-040 |                              |                     | 4                         | 4.25                                | 4.40 | 4.55  | 4.72 | 5.11 |
| HGLRS 4006-01-020  |                              | RO.1                | 2                         | 2.18                                | 2.25 | 2.33  | 2.42 | 2.61 |
| HGLRS 4006-01-040  |                              |                     | 4                         | 4.25                                | 4.39 | 4.55  | 4.72 | 5.10 |
| HGLRS 4008-005-020 | 0.8                          | RO.05               | 2                         | 2.54                                | 2.72 | 2.89  | 3.03 | 3.30 |
| HGLRS 4008-005-040 |                              |                     | 4                         | 4.68                                | 4.94 | 5.16  | 5.35 | 5.79 |
| HGLRS 4008-005-060 |                              |                     | 6                         | 6.80                                | 7.11 | 7.37  | 7.65 | 8.27 |
| HGLRS 4008-01-020  |                              | RO.1                | 2                         | 2.54                                | 2.72 | 2.88  | 3.02 | 3.29 |
| HGLRS 4008-01-040  |                              |                     | 4                         | 4.68                                | 4.93 | 5.15  | 5.34 | 5.77 |
| HGLRS 4008-01-060  |                              |                     | 6                         | 6.79                                | 7.11 | 7.37  | 7.64 | 8.26 |
| HGLRS 4008-02-020  |                              | RO.2                | 2                         | 2.53                                | 2.70 | 2.86  | 3.00 | 3.26 |
| HGLRS 4008-02-040  |                              |                     | 4                         | 4.67                                | 4.92 | 5.14  | 5.33 | 5.75 |
| HGLRS 4008-02-060  |                              |                     | 6                         | 6.78                                | 7.10 | 7.36  | 7.63 | 8.24 |
| HGLRS 4010-002-020 | 1                            | RO.02               | 2                         | 2.58                                | 2.76 | 2.92  | 3.06 | 3.33 |
| HGLRS 4010-002-030 |                              |                     | 3                         | 3.65                                | 3.87 | 4.06  | 4.23 | 4.57 |
| HGLRS 4010-002-040 |                              |                     | 4                         | 4.71                                | 4.97 | 5.18  | 5.38 | 5.81 |
| HGLRS 4010-002-050 |                              |                     | 5                         | 5.77                                | 6.05 | 6.29  | 6.53 | 7.06 |

4 Flutes

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
BallTaper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Next Page →

Unit (mm)

| Model Number       | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |      |     |    |       |
|--------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|------|-----|----|-------|
| HGLRS 4010-005-020 | 1                         | RO.05            | 2                         | 0.8                  | 0.98                     | 16°                       | 50               | 4                       | 7,400                    |      |     |    |       |
| HGLRS 4010-005-030 |                           |                  | 3                         |                      |                          |                           | 50               | 4                       | 7,400                    |      |     |    |       |
| HGLRS 4010-005-040 |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 7,400                    |      |     |    |       |
| HGLRS 4010-005-050 |                           |                  | 5                         |                      |                          |                           | 50               | 4                       | 8,100                    |      |     |    |       |
| HGLRS 4010-01-020  |                           | RO.1             | 2                         |                      |                          |                           | 50               | 4                       | 7,400                    |      |     |    |       |
| HGLRS 4010-01-030  |                           |                  | 3                         |                      |                          |                           | 50               | 4                       | 7,400                    |      |     |    |       |
| HGLRS 4010-01-040  |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 7,400                    |      |     |    |       |
| HGLRS 4010-01-050  |                           |                  | 5                         |                      |                          |                           | 50               | 4                       | 8,100                    |      |     |    |       |
| HGLRS 4010-02-020  |                           | RO.2             | 2                         |                      |                          |                           | 50               | 4                       | 7,400                    |      |     |    |       |
| HGLRS 4010-02-030  |                           |                  | 3                         |                      |                          |                           | 50               | 4                       | 7,400                    |      |     |    |       |
| HGLRS 4010-02-040  |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 7,400                    |      |     |    |       |
| HGLRS 4010-02-050  |                           |                  | 5                         |                      |                          |                           | 50               | 4                       | 8,100                    |      |     |    |       |
| HGLRS 4015-005-030 | 1.5                       | RO.05            | 3                         | 1.2                  | 1.48                     | 16°                       | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-005-040 |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-005-060 |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-005-080 |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,200                    |      |     |    |       |
| HGLRS 4015-01-030  |                           | RO.1             | 3                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-01-040  |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-01-060  |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-01-080  |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,200                    |      |     |    |       |
| HGLRS 4015-02-030  |                           | RO.2             | 3                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-02-040  |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-02-060  |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-02-080  |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,200                    |      |     |    |       |
| HGLRS 4015-03-030  |                           | RO.3             | 3                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-03-040  |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-03-060  |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-03-080  |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,200                    |      |     |    |       |
| HGLRS 4015-05-040  |                           | RO.5             | 4                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-05-060  |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |       |
| HGLRS 4015-05-080  |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,200                    |      |     |    |       |
| HGLRS 4020-002-040 |                           |                  | 2                         |                      |                          |                           | RO.02            | 4                       | 1.6                      | 1.96 | 16° | 50 | 4     |
| HGLRS 4020-002-060 |                           | 6                |                           |                      |                          |                           |                  | 50                      |                          |      |     | 4  | 7,900 |
| HGLRS 4020-002-080 |                           | 8                |                           |                      |                          |                           |                  | 50                      |                          |      |     | 4  | 8,200 |
| HGLRS 4020-002-100 |                           | 10               |                           |                      |                          |                           |                  | 50                      |                          |      |     | 4  | 8,200 |
| HGLRS 4020-005-040 |                           | RO.05            |                           |                      |                          |                           | 4                | 50                      |                          |      |     | 4  | 7,900 |
| HGLRS 4020-005-060 | 6                         |                  |                           | 50                   | 4                        | 7,900                     |                  |                         |                          |      |     |    |       |
| HGLRS 4020-005-080 | 8                         |                  |                           | 50                   | 4                        | 8,200                     |                  |                         |                          |      |     |    |       |
| HGLRS 4020-005-100 | 10                        |                  |                           | 50                   | 4                        | 8,200                     |                  |                         |                          |      |     |    |       |
| HGLRS 4020-01-040  | RO.1                      | 4                |                           | 50                   | 4                        | 7,900                     |                  |                         |                          |      |     |    |       |
| HGLRS 4020-01-060  |                           | 6                |                           | 50                   | 4                        | 7,900                     |                  |                         |                          |      |     |    |       |
| HGLRS 4020-01-080  |                           | 8                |                           | 50                   | 4                        | 8,200                     |                  |                         |                          |      |     |    |       |
| HGLRS 4020-01-100  |                           | 10               |                           | 50                   | 4                        | 8,200                     |                  |                         |                          |      |     |    |       |
| HGLRS 4020-02-040  | RO.2                      | 4                |                           | 50                   | 4                        | 7,900                     |                  |                         |                          |      |     |    |       |
| HGLRS 4020-02-060  |                           | 6                |                           | 50                   | 4                        | 7,900                     |                  |                         |                          |      |     |    |       |
| HGLRS 4020-02-080  |                           | 8                |                           | 50                   | 4                        | 8,200                     |                  |                         |                          |      |     |    |       |
| HGLRS 4020-02-100  |                           | 10               |                           | 50                   | 4                        | 8,200                     |                  |                         |                          |      |     |    |       |

- $\phi 3$ mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Unit (mm)

| Model Number       | Outside Diameter<br>$\phi D$ | Corner Radius<br>CR | Effective Length<br>$l_1$ | Effective Length by Inclined Angles |       |       |       |       |      |
|--------------------|------------------------------|---------------------|---------------------------|-------------------------------------|-------|-------|-------|-------|------|
|                    |                              |                     |                           | 30'                                 | 1°    | 1°30' | 2°    | 3°    |      |
| HGLRS 4010-005-020 | 1                            | RO.05               | 2                         | 2.58                                | 2.76  | 2.91  | 3.06  | 3.32  |      |
| HGLRS 4010-005-030 |                              |                     | 3                         | 3.65                                | 3.87  | 4.05  | 4.22  | 4.56  |      |
| HGLRS 4010-005-040 |                              |                     | 4                         | 4.71                                | 4.96  | 5.18  | 5.37  | 5.81  |      |
| HGLRS 4010-005-050 |                              |                     | 5                         | 5.77                                | 6.05  | 6.29  | 6.52  | 7.05  |      |
| HGLRS 4010-01-020  |                              | RO.1                | 2                         | 2.58                                | 2.75  | 2.90  | 3.05  | 3.31  |      |
| HGLRS 4010-01-030  |                              |                     | 3                         | 3.65                                | 3.86  | 4.05  | 4.21  | 4.55  |      |
| HGLRS 4010-01-040  |                              |                     | 4                         | 4.71                                | 4.96  | 5.17  | 5.36  | 5.80  |      |
| HGLRS 4010-01-050  |                              |                     | 5                         | 5.77                                | 6.05  | 6.28  | 6.51  | 7.04  |      |
| HGLRS 4010-02-020  |                              | RO.2                | 2                         | 2.57                                | 2.74  | 2.89  | 3.03  | 3.29  |      |
| HGLRS 4010-02-030  |                              |                     | 3                         | 3.64                                | 3.85  | 4.03  | 4.20  | 4.53  |      |
| HGLRS 4010-02-040  |                              |                     | 4                         | 4.70                                | 4.95  | 5.16  | 5.35  | 5.77  |      |
| HGLRS 4010-02-050  |                              |                     | 5                         | 5.76                                | 6.04  | 6.27  | 6.50  | 7.02  |      |
| HGLRS 4015-005-030 |                              | 1.5                 | RO.05                     | 3                                   | 3.12  | 3.23  | 3.35  | 3.48  | 3.76 |
| HGLRS 4015-005-040 |                              |                     |                           | 4                                   | 4.16  | 4.30  | 4.46  | 4.63  | 5.00 |
| HGLRS 4015-005-060 |                              |                     |                           | 6                                   | 6.22  | 6.44  | 6.67  | 6.92  | 7.49 |
| HGLRS 4015-005-080 |                              |                     |                           | 8                                   | 8.29  | 8.58  | 8.89  | 9.22  | 9.97 |
| HGLRS 4015-01-030  | RO.1                         |                     | 3                         | 3.12                                | 3.23  | 3.34  | 3.47  | 3.75  |      |
| HGLRS 4015-01-040  |                              |                     | 4                         | 4.16                                | 4.30  | 4.45  | 4.62  | 4.99  |      |
| HGLRS 4015-01-060  |                              |                     | 6                         | 6.22                                | 6.44  | 6.67  | 6.92  | 7.48  |      |
| HGLRS 4015-01-080  |                              |                     | 8                         | 8.29                                | 8.58  | 8.89  | 9.22  | 9.96  |      |
| HGLRS 4015-02-030  | RO.2                         |                     | 3                         | 3.12                                | 3.22  | 3.33  | 3.45  | 3.72  |      |
| HGLRS 4015-02-040  |                              |                     | 4                         | 4.15                                | 4.29  | 4.44  | 4.60  | 4.97  |      |
| HGLRS 4015-02-060  |                              |                     | 6                         | 6.22                                | 6.43  | 6.66  | 6.90  | 7.45  |      |
| HGLRS 4015-02-080  |                              |                     | 8                         | 8.29                                | 8.57  | 8.87  | 9.20  | 9.94  |      |
| HGLRS 4015-03-030  | RO.3                         |                     | 3                         | 3.12                                | 3.22  | 3.32  | 3.44  | 3.70  |      |
| HGLRS 4015-03-040  |                              |                     | 4                         | 4.15                                | 4.28  | 4.43  | 4.59  | 4.94  |      |
| HGLRS 4015-03-060  |                              |                     | 6                         | 6.22                                | 6.42  | 6.65  | 6.89  | 7.43  |      |
| HGLRS 4015-03-080  |                              |                     | 8                         | 8.28                                | 8.56  | 8.86  | 9.19  | 9.91  |      |
| HGLRS 4015-05-040  | RO.5                         | 4                   | 4.14                      | 4.27                                | 4.41  | 4.56  | 4.89  |       |      |
| HGLRS 4015-05-060  |                              | 6                   | 6.21                      | 6.41                                | 6.63  | 6.86  | 7.38  |       |      |
| HGLRS 4015-05-080  |                              | 8                   | 8.28                      | 8.55                                | 8.84  | 9.16  | 9.87  |       |      |
| HGLRS 4020-002-040 |                              | 2                   | RO.02                     | 4                                   | 4.20  | 4.34  | 4.50  | 4.67  | 5.05 |
| HGLRS 4020-002-060 | 6                            |                     |                           | 6.26                                | 6.48  | 6.72  | 6.97  | 7.54  |      |
| HGLRS 4020-002-080 | 8                            |                     |                           | 8.33                                | 8.62  | 8.94  | 9.27  | 10.03 |      |
| HGLRS 4020-002-100 | 10                           |                     |                           | 10.40                               | 10.76 | 11.15 | 11.57 | 12.51 |      |
| HGLRS 4020-005-040 | RO.05                        |                     | 4                         | 4.20                                | 4.34  | 4.50  | 4.67  | 5.05  |      |
| HGLRS 4020-005-060 |                              |                     | 6                         | 6.26                                | 6.48  | 6.72  | 6.97  | 7.53  |      |
| HGLRS 4020-005-080 |                              |                     | 8                         | 8.33                                | 8.62  | 8.93  | 9.27  | 10.02 |      |
| HGLRS 4020-005-100 |                              |                     | 10                        | 10.40                               | 10.76 | 11.15 | 11.57 | 12.51 |      |
| HGLRS 4020-01-040  | RO.1                         |                     | 4                         | 4.19                                | 4.34  | 4.49  | 4.66  | 5.04  |      |
| HGLRS 4020-01-060  |                              |                     | 6                         | 6.26                                | 6.48  | 6.71  | 6.96  | 7.52  |      |
| HGLRS 4020-01-080  |                              |                     | 8                         | 8.33                                | 8.62  | 8.93  | 9.26  | 10.01 |      |
| HGLRS 4020-01-100  |                              |                     | 10                        | 10.40                               | 10.76 | 11.14 | 11.56 | 12.49 |      |
| HGLRS 4020-02-040  | RO.2                         |                     | 4                         | 4.19                                | 4.33  | 4.48  | 4.65  | 5.01  |      |
| HGLRS 4020-02-060  |                              |                     | 6                         | 6.26                                | 6.47  | 6.70  | 6.95  | 7.50  |      |
| HGLRS 4020-02-080  |                              |                     | 8                         | 8.33                                | 8.61  | 8.92  | 9.25  | 9.98  |      |
| HGLRS 4020-02-100  |                              |                     | 10                        | 10.39                               | 10.75 | 11.13 | 11.54 | 12.47 |      |

4 Flutes

 $\phi 3$ mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

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Unit (mm)

| Model Number       | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |      |     |    |   |       |
|--------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|------|-----|----|---|-------|
| HGLRS 4020-03-040  | 2                         | RO.3             | 4                         | 1.6                  | 1.96                     | 16°                       | 50               | 4                       | 7,900                    |      |     |    |   |       |
| HGLRS 4020-03-060  |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |   |       |
| HGLRS 4020-03-080  |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,200                    |      |     |    |   |       |
| HGLRS 4020-03-100  |                           |                  | 10                        |                      |                          |                           | 50               | 4                       | 8,200                    |      |     |    |   |       |
| HGLRS 4020-05-040  |                           | RO.5             | 4                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |   |       |
| HGLRS 4020-05-060  |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 7,900                    |      |     |    |   |       |
| HGLRS 4020-05-080  |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,200                    |      |     |    |   |       |
| HGLRS 4020-05-100  |                           |                  | 10                        |                      |                          |                           | 50               | 4                       | 8,200                    |      |     |    |   |       |
| HGLRS 4030-005-040 |                           |                  | 3                         |                      |                          |                           | RO.05            | 4                       | 2.4                      | 2.87 | 16° | 50 | 6 | 7,100 |
| HGLRS 4030-005-060 |                           |                  |                           |                      |                          |                           |                  | 6                       |                          |      |     | 50 | 6 | 7,100 |
| HGLRS 4030-005-080 | 8                         | 50               |                           | 6                    | 7,100                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-005-100 | 10                        | 50               |                           | 6                    | 7,100                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-005-120 | 12                        | 50               |                           | 6                    | 8,600                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-005-160 | 16                        | 60               |                           | 6                    | 10,600                   |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-01-040  | RO.1                      | 4                |                           | 50                   | 6                        | 7,100                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-01-060  |                           | 6                |                           | 50                   | 6                        | 7,100                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-01-080  |                           | 8                |                           | 50                   | 6                        | 7,100                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-01-100  |                           | 10               |                           | 50                   | 6                        | 7,100                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-01-120  |                           | 12               |                           | 50                   | 6                        | 8,600                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-01-160  |                           | 16               |                           | 60                   | 6                        | 10,600                    |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-02-040  | RO.2                      | 4                |                           | 50                   | 6                        | 7,100                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-02-060  |                           | 6                |                           | 50                   | 6                        | 7,100                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-02-080  |                           | 8                |                           | 50                   | 6                        | 7,100                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-02-100  |                           | 10               |                           | 50                   | 6                        | 7,100                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-02-120  |                           | 12               | 50                        | 6                    | 8,600                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-02-160  |                           | 16               | 60                        | 6                    | 10,600                   |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-03-040  |                           | RO.3             | 4                         | 50                   | 6                        | 7,100                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-03-060  |                           |                  | 6                         | 50                   | 6                        | 7,100                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-03-080  | 8                         |                  | 50                        | 6                    | 7,100                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-03-100  | 10                        |                  | 50                        | 6                    | 7,100                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-03-120  | 12                        |                  | 50                        | 6                    | 8,600                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-03-160  | 16                        |                  | 60                        | 6                    | 10,600                   |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-05-040  | RO.5                      | 4                | 50                        | 6                    | 7,100                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-05-060  |                           | 6                | 50                        | 6                    | 7,100                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-05-080  |                           | 8                | 50                        | 6                    | 7,100                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-05-100  |                           | 10               | 50                        | 6                    | 7,100                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-05-120  |                           | 12               | 50                        | 6                    | 8,600                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-05-160  |                           | 16               | 60                        | 6                    | 10,600                   |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-10-060  |                           | R1               | 6                         | 50                   | 6                        | 7,100                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-10-080  |                           |                  | 8                         | 50                   | 6                        | 7,100                     |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-10-100  | 10                        |                  | 50                        | 6                    | 7,100                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-10-120  | 12                        |                  | 50                        | 6                    | 8,600                    |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4030-10-160  |                           | 16               | 60                        | 6                    | 10,600                   |                           |                  |                         |                          |      |     |    |   |       |
| HGLRS 4040-005-080 | 4                         | RO.05            | 8                         | 3.2                  | 3.77                     | 16°                       | 60               | 6                       | 10,600                   |      |     |    |   |       |
| HGLRS 4040-005-120 |                           |                  | 12                        |                      |                          |                           | 60               | 6                       | 10,600                   |      |     |    |   |       |
| HGLRS 4040-005-160 |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 10,600                   |      |     |    |   |       |
| HGLRS 4040-005-200 |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 11,800                   |      |     |    |   |       |

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- $\phi 3$ mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Unit (mm)

| Model Number       | Outside Diameter<br>$\phi D$ | Corner Radius<br>CR | Effective Length<br>$l_1$ | Effective Length by Inclined Angles |       |       |       |                 |      |
|--------------------|------------------------------|---------------------|---------------------------|-------------------------------------|-------|-------|-------|-----------------|------|
|                    |                              |                     |                           | 30'                                 | 1°    | 1°30' | 2°    | 3°              |      |
| HGLRS 4020-03-040  | 2                            | RO.3                | 4                         | 4.19                                | 4.32  | 4.47  | 4.63  | 4.99            |      |
| HGLRS 4020-03-060  |                              |                     | 6                         | 6.25                                | 6.46  | 6.69  | 6.93  | 7.47            |      |
| HGLRS 4020-03-080  |                              |                     | 8                         | 8.32                                | 8.60  | 8.91  | 9.23  | 9.96            |      |
| HGLRS 4020-03-100  |                              |                     | 10                        | 10.39                               | 10.74 | 11.12 | 11.53 | 12.45           |      |
| HGLRS 4020-05-040  |                              | RO.5                | 4                         | 4.18                                | 4.31  | 4.45  | 4.60  | 4.94            |      |
| HGLRS 4020-05-060  |                              |                     | 6                         | 6.25                                | 6.45  | 6.67  | 6.90  | 7.43            |      |
| HGLRS 4020-05-080  |                              |                     | 8                         | 8.32                                | 8.59  | 8.88  | 9.20  | 9.91            |      |
| HGLRS 4020-05-100  |                              |                     | 10                        | 10.38                               | 10.73 | 11.10 | 11.50 | 12.40           |      |
| HGLRS 4030-005-040 |                              | 3                   | RO.05                     | 4                                   | 4.39  | 4.54  | 4.70  | 4.88            | 5.28 |
| HGLRS 4030-005-060 |                              |                     |                           | 6                                   | 6.45  | 6.68  | 6.92  | 7.18            | 7.76 |
| HGLRS 4030-005-080 | 8                            |                     |                           | 8.52                                | 8.82  | 9.14  | 9.48  | 10.25           |      |
| HGLRS 4030-005-100 | 10                           |                     |                           | 10.59                               | 10.96 | 11.35 | 11.78 | 12.74           |      |
| HGLRS 4030-005-120 | 12                           |                     |                           | 12.66                               | 13.10 | 13.57 | 14.08 | 15.22           |      |
| HGLRS 4030-005-160 | 16                           |                     |                           | 16.79                               | 17.38 | 18.00 | 18.68 | 20.19           |      |
| HGLRS 4030-01-040  | RO.1                         |                     | 4                         | 4.38                                | 4.54  | 4.70  | 4.87  | 5.27            |      |
| HGLRS 4030-01-060  |                              |                     | 6                         | 6.45                                | 6.68  | 6.92  | 7.17  | 7.75            |      |
| HGLRS 4030-01-080  |                              |                     | 8                         | 8.52                                | 8.81  | 9.13  | 9.47  | 10.24           |      |
| HGLRS 4030-01-100  |                              |                     | 10                        | 10.59                               | 10.95 | 11.35 | 11.77 | 12.72           |      |
| HGLRS 4030-01-120  |                              |                     | 12                        | 12.65                               | 13.09 | 13.56 | 14.07 | 15.21           |      |
| HGLRS 4030-01-160  |                              |                     | 16                        | 16.79                               | 17.37 | 18.00 | 18.67 | 20.18           |      |
| HGLRS 4030-02-040  | RO.2                         |                     | 4                         | 4.38                                | 4.53  | 4.69  | 4.86  | 5.24            |      |
| HGLRS 4030-02-060  |                              |                     | 6                         | 6.45                                | 6.67  | 6.90  | 7.16  | 7.73            |      |
| HGLRS 4030-02-080  |                              |                     | 8                         | 8.52                                | 8.81  | 9.12  | 9.46  | 10.21           |      |
| HGLRS 4030-02-100  |                              |                     | 10                        | 10.58                               | 10.95 | 11.34 | 11.76 | 12.70           |      |
| HGLRS 4030-02-120  |                              | 12                  | 12.65                     | 13.09                               | 13.55 | 14.06 | 15.19 |                 |      |
| HGLRS 4030-02-160  |                              | 16                  | 16.79                     | 17.37                               | 17.99 | 18.66 | 20.16 |                 |      |
| HGLRS 4030-03-040  | 3                            | RO.3                | 4                         | 4.38                                | 4.52  | 4.68  | 4.84  | 5.22            |      |
| HGLRS 4030-03-060  |                              |                     | 6                         | 6.45                                | 6.66  | 6.89  | 7.14  | 7.70            |      |
| HGLRS 4030-03-080  |                              |                     | 8                         | 8.51                                | 8.80  | 9.11  | 9.44  | 10.19           |      |
| HGLRS 4030-03-100  |                              |                     | 10                        | 10.58                               | 10.94 | 11.33 | 11.74 | 12.68           |      |
| HGLRS 4030-03-120  |                              |                     | 12                        | 12.65                               | 13.08 | 13.54 | 14.04 | 15.16           |      |
| HGLRS 4030-03-160  |                              |                     | 16                        | 16.78                               | 17.36 | 17.98 | 18.64 | 20.14           |      |
| HGLRS 4030-05-040  |                              | RO.5                | 4                         | 4.37                                | 4.51  | 4.66  | 4.81  | 5.17            |      |
| HGLRS 4030-05-060  |                              |                     | 6                         | 6.44                                | 6.65  | 6.87  | 7.11  | 7.66            |      |
| HGLRS 4030-05-080  |                              |                     | 8                         | 8.51                                | 8.79  | 9.09  | 9.41  | 10.14           |      |
| HGLRS 4030-05-100  |                              |                     | 10                        | 10.57                               | 10.93 | 11.31 | 11.71 | 12.63           |      |
| HGLRS 4030-05-120  | 12                           |                     | 12.64                     | 13.07                               | 13.52 | 14.01 | 15.12 |                 |      |
| HGLRS 4030-05-160  | 16                           |                     | 16.78                     | 17.34                               | 17.96 | 18.61 | 20.09 |                 |      |
| HGLRS 4030-10-060  | R1                           | 6                   | 6.42                      | 6.61                                | 6.81  | 7.04  | 7.53  |                 |      |
| HGLRS 4030-10-080  |                              | 8                   | 8.49                      | 8.75                                | 9.03  | 9.34  | 10.02 |                 |      |
| HGLRS 4030-10-100  |                              | 10                  | 10.55                     | 10.89                               | 11.25 | 11.64 | 12.51 |                 |      |
| HGLRS 4030-10-120  |                              | 12                  | 12.62                     | 13.03                               | 13.46 | 13.94 | 14.99 |                 |      |
| HGLRS 4030-10-160  |                              | 16                  | 16.75                     | 17.31                               | 17.90 | 18.53 | 19.97 |                 |      |
| HGLRS 4040-005-080 | 4                            | RO.05               | 8                         | 8.71                                | 9.02  | 9.34  | 9.69  | 10.48           |      |
| HGLRS 4040-005-120 |                              |                     | 12                        | 12.85                               | 13.29 | 13.78 | 14.29 | 15.45           |      |
| HGLRS 4040-005-160 |                              |                     | 16                        | 16.98                               | 17.57 | 18.21 | 18.89 | No Interference |      |
| HGLRS 4040-005-200 |                              |                     | 20                        | 21.12                               | 21.85 | 22.64 | 23.49 | No Interference |      |

4 Flutes

 $\phi 3$ mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Square  
Long Neck  
SquareRadius  
Radius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
BallTaper Neck  
BallTaper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

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Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|
| HGLRS 4040-01-080 | 4                         | RO.1             | 8                         | 3.2                  | 3.77                     | 16°                       | 60               | 6                       | 10,600                   |
| HGLRS 4040-01-120 |                           |                  | 12                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-01-160 |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-01-200 |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 11,800                   |
| HGLRS 4040-02-080 |                           | RO.2             | 8                         |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-02-120 |                           |                  | 12                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-02-160 |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-02-200 |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 11,800                   |
| HGLRS 4040-03-080 |                           | RO.3             | 8                         |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-03-120 |                           |                  | 12                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-03-160 |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-03-200 |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 11,800                   |
| HGLRS 4040-05-080 |                           | RO.5             | 8                         |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-05-120 |                           |                  | 12                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-05-160 |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-05-200 |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 11,800                   |
| HGLRS 4040-10-080 |                           | R1               | 8                         |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-10-120 |                           |                  | 12                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-10-160 |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HGLRS 4040-10-200 |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 11,800                   |
| HGLRS 4060-01-120 | 6                         | RO.1             | 12                        | 4.8                  | 5.77                     | —                         | 60               | 6                       | 15,400                   |
| HGLRS 4060-01-160 |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 15,400                   |
| HGLRS 4060-01-200 |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 15,400                   |
| HGLRS 4060-01-240 |                           |                  | 24                        |                      |                          |                           | 70               | 6                       | 15,400                   |
| HGLRS 4060-01-300 |                           |                  | 30                        |                      |                          |                           | 100              | 6                       | 18,000                   |
| HGLRS 4060-02-120 |                           | RO.2             | 12                        |                      |                          |                           | 60               | 6                       | 15,400                   |
| HGLRS 4060-02-160 |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 15,400                   |
| HGLRS 4060-02-200 |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 15,400                   |
| HGLRS 4060-02-240 |                           |                  | 24                        |                      |                          |                           | 70               | 6                       | 15,400                   |
| HGLRS 4060-02-300 |                           |                  | 30                        |                      |                          |                           | 100              | 6                       | 18,000                   |
| HGLRS 4060-03-120 |                           | RO.3             | 12                        |                      |                          |                           | 60               | 6                       | 15,400                   |
| HGLRS 4060-03-160 |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 15,400                   |
| HGLRS 4060-03-200 |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 15,400                   |
| HGLRS 4060-03-240 |                           |                  | 24                        |                      |                          |                           | 70               | 6                       | 15,400                   |
| HGLRS 4060-03-300 |                           |                  | 30                        |                      |                          |                           | 100              | 6                       | 18,000                   |
| HGLRS 4060-05-120 |                           | RO.5             | 12                        |                      |                          |                           | 60               | 6                       | 15,400                   |
| HGLRS 4060-05-160 |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 15,400                   |
| HGLRS 4060-05-200 |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 15,400                   |
| HGLRS 4060-05-240 |                           |                  | 24                        |                      |                          |                           | 70               | 6                       | 15,400                   |
| HGLRS 4060-05-300 |                           |                  | 30                        |                      |                          |                           | 100              | 6                       | 18,000                   |
| HGLRS 4060-10-120 |                           | R1               | 12                        |                      |                          |                           | 60               | 6                       | 15,400                   |
| HGLRS 4060-10-160 |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 15,400                   |
| HGLRS 4060-10-200 |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 15,400                   |
| HGLRS 4060-10-240 |                           |                  | 24                        |                      |                          |                           | 70               | 6                       | 15,400                   |
| HGLRS 4060-10-300 |                           |                  | 30                        |                      |                          |                           | 100              | 6                       | 18,000                   |

Next Page ➡

- 3mm Shank V Series
- UDC-PCD Series
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- Square
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- Ball / Long Shank Ball
- Long Neck Ball
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- Taper
- Barrel
- Spiral V Cutter
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Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|-------------------|---------------------------|------------------|------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|                   |                           |                  |                        | 30°                                 | 1°              | 1°30'           | 2°              | 3°              |
| HGLRS 4040-01-080 | 4                         | RO.1             | 8                      | 8.71                                | 9.01            | 9.34            | 9.68            | 10.47           |
| HGLRS 4040-01-120 |                           |                  | 12                     | 12.85                               | 13.29           | 13.77           | 14.28           | 15.44           |
| HGLRS 4040-01-160 |                           |                  | 16                     | 16.98                               | 17.57           | 18.20           | 18.88           | No Interference |
| HGLRS 4040-01-200 |                           |                  | 20                     | 21.11                               | 21.85           | 22.64           | 23.48           | No Interference |
| HGLRS 4040-02-080 |                           | RO.2             | 8                      | 8.71                                | 9.01            | 9.33            | 9.67            | 10.44           |
| HGLRS 4040-02-120 |                           |                  | 12                     | 12.84                               | 13.28           | 13.76           | 14.27           | 15.42           |
| HGLRS 4040-02-160 |                           |                  | 16                     | 16.98                               | 17.56           | 18.19           | 18.87           | No Interference |
| HGLRS 4040-02-200 |                           |                  | 20                     | 21.11                               | 21.84           | 22.63           | 23.47           | No Interference |
| HGLRS 4040-03-080 |                           | RO.3             | 8                      | 8.70                                | 9.00            | 9.32            | 9.66            | 10.42           |
| HGLRS 4040-03-120 |                           |                  | 12                     | 12.84                               | 13.28           | 13.75           | 14.25           | 15.39           |
| HGLRS 4040-03-160 |                           |                  | 16                     | 16.97                               | 17.56           | 18.18           | 18.85           | No Interference |
| HGLRS 4040-03-200 |                           |                  | 20                     | 21.11                               | 21.83           | 22.61           | 23.45           | No Interference |
| HGLRS 4040-05-080 |                           | RO.5             | 8                      | 8.70                                | 8.98            | 9.29            | 9.63            | 10.37           |
| HGLRS 4040-05-120 |                           |                  | 12                     | 12.83                               | 13.26           | 13.73           | 14.23           | 15.35           |
| HGLRS 4040-05-160 |                           |                  | 16                     | 16.97                               | 17.54           | 18.16           | 18.82           | No Interference |
| HGLRS 4040-05-200 |                           |                  | 20                     | 21.10                               | 21.82           | 22.59           | 23.42           | No Interference |
| HGLRS 4040-10-080 |                           | R1               | 8                      | 8.68                                | 8.95            | 9.24            | 9.55            | 10.25           |
| HGLRS 4040-10-120 |                           |                  | 12                     | 12.81                               | 13.23           | 13.67           | 14.15           | 15.22           |
| HGLRS 4040-10-160 |                           |                  | 16                     | 16.95                               | 17.50           | 18.10           | 18.75           | 20.19           |
| HGLRS 4040-10-200 |                           |                  | 20                     | 21.08                               | 21.78           | 22.54           | 23.35           | No Interference |
| HGLRS 4060-01-120 | 6                         | RO.1             | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-01-160 |                           |                  | 16                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-01-200 |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-01-240 |                           |                  | 24                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-01-300 |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-02-120 |                           | RO.2             | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-02-160 |                           |                  | 16                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-02-200 |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-02-240 |                           |                  | 24                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-02-300 |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-03-120 |                           | RO.3             | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-03-160 |                           |                  | 16                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-03-200 |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-03-240 |                           |                  | 24                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-03-300 |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-05-120 |                           | RO.5             | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-05-160 |                           |                  | 16                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-05-200 |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-05-240 |                           |                  | 24                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-05-300 |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-10-120 |                           | R1               | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-10-160 |                           |                  | 16                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-10-200 |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-10-240 |                           |                  | 24                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HGLRS 4060-10-300 |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |

4 Flutes

$\phi 3\text{mm}$  Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Milling Conditions for HGLRS

| WORK MATERIAL |                       |                    |                       | PREHARDENED STEELS / HARDENED STEELS NAK / STAVAX (~55HRC) |                    |                                 |                                  | HARDENED STEELS SKD11 (55~62HRC)   |                    |                                 |                                  | HARDENED STEELS HAP10 (62~66HRC)   |                    |                                 |                                  | HARDENED STEELS HAP72 (66~70HRC)   |                    |                                 |                                  |      |      |
|---------------|-----------------------|--------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------|------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |      |      |
| 4002          | 0.2                   | R0.02              | 0.5                   | 27,000   | 500                | 0.004                           | 0.05                             | 27,000                             | 260                | 0.003                           | 0.02                             | 27,000                             | 280                | 0.003                           | 0.01                             | 27,000                             | 250                | 0.003                           | 0.01                             |      |      |
|               |                       |                    | 1                     | 27,000   | 390                | 0.004                           | 0.05                             | 27,000                             | 170                | 0.003                           | 0.02                             | 27,000                             | 210                | 0.003                           | 0.01                             | 27,000                             | 190                | 0.003                           | 0.01                             |      |      |
|               |                       |                    | 2                     | 27,000   | 80                 | 0.004                           | 0.05                             | 27,000                             | 25                 | 0.003                           | 0.02                             | 27,000                             | 30                 | 0.003                           | 0.01                             | 27,000                             | 25                 | 0.003                           | 0.01                             |      |      |
|               |                       | R0.05              | 0.5                   | 27,000   | 590                | 0.004                           | 0.05                             | 27,000                             | 260                | 0.003                           | 0.02                             | 27,000                             | 280                | 0.003                           | 0.01                             | 27,000                             | 250                | 0.003                           | 0.01                             |      |      |
|               |                       |                    | 1                     | 27,000   | 450                | 0.004                           | 0.05                             | 27,000                             | 170                | 0.003                           | 0.02                             | 27,000                             | 210                | 0.003                           | 0.01                             | 27,000                             | 190                | 0.003                           | 0.01                             |      |      |
|               |                       |                    | 2                     | 27,000   | 80                 | 0.004                           | 0.05                             | 27,000                             | 25                 | 0.003                           | 0.02                             | 27,000                             | 30                 | 0.003                           | 0.01                             | 27,000                             | 25                 | 0.003                           | 0.01                             |      |      |
| 4003          | 0.3                   | R0.02              | 0.5                   | 25,500   | 600                | 0.008                           | 0.09                             | 25,500                             | 460                | 0.003                           | 0.04                             | 25,500                             | 480                | 0.003                           | 0.03                             | 25,000                             | 440                | 0.003                           | 0.03                             |      |      |
|               |                       |                    | 1                     | 25,500   | 480                | 0.008                           | 0.09                             | 25,500                             | 440                | 0.003                           | 0.04                             | 25,500                             | 460                | 0.003                           | 0.03                             | 25,000                             | 420                | 0.003                           | 0.03                             |      |      |
|               |                       |                    | 1.5                   | 25,500   | 360                | 0.008                           | 0.09                             | 25,500                             | 280                | 0.003                           | 0.04                             | 25,500                             | 300                | 0.003                           | 0.03                             | 25,000                             | 270                | 0.003                           | 0.03                             |      |      |
|               |                       | R0.05              | 2                     | 25,500   | 240                | 0.008                           | 0.09                             | 25,500                             | 200                | 0.003                           | 0.04                             | 25,500                             | 220                | 0.003                           | 0.03                             | 25,000                             | 200                | 0.003                           | 0.03                             |      |      |
|               |                       |                    | 0.5                   | 25,500   | 700                | 0.008                           | 0.09                             | 25,500                             | 460                | 0.003                           | 0.04                             | 25,500                             | 480                | 0.004                           | 0.03                             | 25,000                             | 440                | 0.004                           | 0.03                             |      |      |
|               |                       |                    | 1                     | 25,500   | 560                | 0.008                           | 0.09                             | 25,500                             | 440                | 0.003                           | 0.04                             | 25,500                             | 460                | 0.004                           | 0.03                             | 25,000                             | 420                | 0.004                           | 0.03                             |      |      |
| 4004          | 0.4                   | R0.02              | 1                     | 23,000   | 720                | 0.01                            | 0.13                             | 18,300                             | 700                | 0.004                           | 0.07                             | 20,500                             | 720                | 0.003                           | 0.05                             | 20,000                             | 650                | 0.003                           | 0.05                             |      |      |
|               |                       |                    | 2                     | 20,500   | 540                | 0.01                            | 0.13                             | 16,100                             | 420                | 0.004                           | 0.07                             | 18,000                             | 440                | 0.003                           | 0.05                             | 17,500                             | 400                | 0.003                           | 0.05                             |      |      |
|               |                       |                    | 1                     | 23,000   | 840                | 0.015                           | 0.13                             | 18,300                             | 700                | 0.004                           | 0.07                             | 20,500                             | 720                | 0.004                           | 0.05                             | 20,000                             | 650                | 0.004                           | 0.05                             |      |      |
|               |                       | R0.05              | 2                     | 20,500   | 630                | 0.015                           | 0.13                             | 16,100                             | 420                | 0.006                           | 0.07                             | 18,000                             | 440                | 0.004                           | 0.05                             | 17,500                             | 400                | 0.004                           | 0.05                             |      |      |
|               |                       |                    | 1                     | 23,000   | 840                | 0.015                           | 0.13                             | 18,300                             | 700                | 0.006                           | 0.07                             | 20,500                             | 720                | 0.007                           | 0.05                             | 20,000                             | 650                | 0.007                           | 0.05                             |      |      |
|               |                       |                    | 2                     | 20,500   | 630                | 0.015                           | 0.13                             | 16,100                             | 420                | 0.006                           | 0.07                             | 18,000                             | 440                | 0.007                           | 0.05                             | 17,500                             | 400                | 0.007                           | 0.05                             |      |      |
| 4005          | 0.5                   | R0.02              | 1                     | 22,500   | 920                | 0.01                            | 0.17                             | 17,900                             | 880                | 0.006                           | 0.09                             | 20,000                             | 900                | 0.004                           | 0.07                             | 19,500                             | 820                | 0.004                           | 0.07                             |      |      |
|               |                       |                    | 2                     | 20,000   | 830                | 0.01                            | 0.17                             | 15,700                             | 660                | 0.006                           | 0.09                             | 17,500                             | 680                | 0.004                           | 0.07                             | 17,000                             | 620                | 0.004                           | 0.07                             |      |      |
|               |                       |                    | 3                     | 18,000   | 730                | 0.01                            | 0.17                             | 13,900                             | 530                | 0.006                           | 0.09                             | 15,500                             | 550                | 0.004                           | 0.07                             | 15,000                             | 500                | 0.004                           | 0.07                             |      |      |
|               |                       | R0.05              | 1                     | 22,500   | 1,080              | 0.017                           | 0.17                             | 17,900                             | 880                | 0.009                           | 0.09                             | 20,000                             | 900                | 0.007                           | 0.07                             | 19,500                             | 820                | 0.007                           | 0.07                             |      |      |
|               |                       |                    | 2                     | 20,000   | 970                | 0.017                           | 0.17                             | 15,700                             | 660                | 0.009                           | 0.09                             | 17,500                             | 680                | 0.007                           | 0.07                             | 17,000                             | 620                | 0.007                           | 0.07                             |      |      |
|               |                       |                    | 3                     | 18,000   | 850                | 0.017                           | 0.17                             | 13,900                             | 530                | 0.009                           | 0.09                             | 15,500                             | 550                | 0.007                           | 0.07                             | 15,000                             | 500                | 0.007                           | 0.07                             |      |      |
| R0.1          | 1                     | 22,500             | 1,080                 | 0.017  | 0.17               | 17,900                          | 880                              | 0.009                              | 0.09               | 20,000                          | 900                              | 0.007                              | 0.07               | 19,500                          | 820                              | 0.007                              | 0.07               |                                 |                                  |      |      |
|               | 2                     | 20,000             | 970                   | 0.017  | 0.17               | 15,700                          | 660                              | 0.009                              | 0.09               | 17,500                          | 680                              | 0.007                              | 0.07               | 17,000                          | 620                              | 0.007                              | 0.07               |                                 |                                  |      |      |
|               | 3                     | 18,000             | 850                   | 0.017  | 0.17               | 13,900                          | 530                              | 0.009                              | 0.09               | 15,500                          | 550                              | 0.007                              | 0.07               | 15,000                          | 500                              | 0.007                              | 0.07               |                                 |                                  |      |      |
| 4006          | 0.6                   | R0.05              | 2                     | 21,500   | 1,050              | 0.021                           | 0.2                              | 17,000                             | 710                | 0.015                           | 0.12                             | 19,000                             | 730                | 0.007                           | 0.1                              | 18,500                             | 660                | 0.007                           | 0.1                              |      |      |
|               |                       |                    | 4                     | 17,000   | 730                | 0.021                           | 0.2                              | 13,000                             | 310                | 0.015                           | 0.12                             | 14,500                             | 330                | 0.007                           | 0.1                              | 14,000                             | 300                | 0.007                           | 0.1                              |      |      |
|               |                       | R0.1               | 2                     | 21,500   | 1,050              | 0.021                           | 0.2                              | 17,000                             | 710                | 0.015                           | 0.12                             | 19,000                             | 730                | 0.007                           | 0.1                              | 18,500                             | 660                | 0.007                           | 0.1                              |      |      |
|               |                       |                    | 4                     | 17,000   | 730                | 0.021                           | 0.2                              | 13,000                             | 310                | 0.015                           | 0.12                             | 14,500                             | 330                | 0.007                           | 0.1                              | 14,000                             | 300                | 0.007                           | 0.1                              |      |      |
|               |                       | 4008               | 0.8                   | R0.05  | 2                  | 20,500                          | 1,330                            | 0.028                              | 0.26               | 15,700                          | 830                              | 0.02                               | 0.16               | 17,500                          | 850                              | 0.01                               | 0.15               | 15,500                          | 770                              | 0.01 | 0.15 |
|               |                       |                    |                       |  | 4                  | 16,500                          | 1,020                            | 0.028                              | 0.26               | 12,500                          | 530                              | 0.02                               | 0.16               | 14,000                          | 550                              | 0.01                               | 0.15               | 13,500                          | 500                              | 0.01 | 0.15 |
| 6             | 14,000                |                    |                       |  | 840                | 0.028                           | 0.26                             | 10,300                             | 420                | 0.02                            | 0.16                             | 11,500                             | 440                | 0.01                            | 0.15                             | 11,000                             | 400                | 0.01                            | 0.15                             |      |      |
| R0.1          | 2                     |                    |                       | 20,500   | 1,330              | 0.028                           | 0.26                             | 15,700                             | 830                | 0.02                            | 0.16                             | 17,500                             | 850                | 0.01                            | 0.15                             | 15,500                             | 770                | 0.01                            | 0.15                             |      |      |
|               | 4                     |                    |                       | 16,500   | 1,020              | 0.028                           | 0.26                             | 12,500                             | 640                | 0.02                            | 0.16                             | 14,000                             | 660                | 0.01                            | 0.15                             | 13,500                             | 600                | 0.01                            | 0.15                             |      |      |
|               | 6                     |                    |                       | 14,000   | 840                | 0.028                           | 0.26                             | 10,300                             | 420                | 0.02                            | 0.16                             | 11,500                             | 440                | 0.01                            | 0.15                             | 11,000                             | 400                | 0.01                            | 0.15                             |      |      |
| R0.2          | 2                     | 20,500             | 1,330                 | 0.028  | 0.26               | 15,700                          | 830                              | 0.02                               | 0.16               | 17,500                          | 850                              | 0.015                              | 0.15               | 15,500                          | 770                              | 0.015                              | 0.15               |                                 |                                  |      |      |
|               | 4                     | 16,500             | 1,020                 | 0.028  | 0.26               | 12,500                          | 640                              | 0.02                               | 0.16               | 14,000                          | 660                              | 0.015                              | 0.15               | 13,500                          | 600                              | 0.015                              | 0.15               |                                 |                                  |      |      |
|               | 6                     | 14,000             | 840                   | 0.028  | 0.26               | 10,300                          | 420                              | 0.02                               | 0.16               | 11,500                          | 440                              | 0.015                              | 0.15               | 11,000                          | 400                              | 0.015                              | 0.15               |                                 |                                  |      |      |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

# Milling Conditions for HGLRS

| WORK MATERIAL                |                       |                    |                       | PREHARDENED STEELS / HARDENED STEELS NAK / STAVAX (~55HRC) |                    |                                 |                                  | HARDENED STEELS SKD11 (55~62HRC)   |                    |                                 |                                  | HARDENED STEELS HAP10 (62~66HRC)   |                    |                                 |                                  | HARDENED STEELS HAP72 (66~70HRC)   |                    |                                 |                                  |       |       |       |
|------------------------------|-----------------------|--------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|-------|-------|-------|
| Model Number                 | Outside Diameter (mm) | Corner Radius (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |       |       |       |
| 4010                         | 1                     | R0.02              | 2                     | 15,300   | 1,200              | 0.004                           | 0.027                            | 10,300                             | 710                | 0.003                           | 0.003                            | 8,900                              | 800                | 0.003                           | 0.003                            | 8,600                              | 780                | 0.003                           | 0.003                            |       |       |       |
|                              |                       |                    | 3                     | 13,200   | 1,150              | 0.004                           | 0.027                            | 9,400                              | 680                | 0.003                           | 0.003                            | 8,500                              | 770                | 0.003                           | 0.003                            | 8,300                              | 750                | 0.003                           | 0.003                            |       |       |       |
|                              |                       |                    | 4                     | 12,000   | 1,070              | 0.003                           | 0.024                            | 8,500                              | 640                | 0.003                           | 0.003                            | 8,100                              | 730                | 0.003                           | 0.003                            | 7,900                              | 710                | 0.003                           | 0.003                            |       |       |       |
|                              |                       |                    | 5                     | 11,000   | 960                | 0.003                           | 0.023                            | 7,800                              | 570                | 0.003                           | 0.003                            | 7,700                              | 700                | 0.003                           | 0.003                            | 7,500                              | 680                | 0.003                           | 0.003                            |       |       |       |
|                              |                       | R0.05              | 2                     | 15,300   | 1,200              | 0.01                            | 0.068                            | 10,300                             | 710                | 0.005                           | 0.006                            | 8,900                              | 800                | 0.004                           | 0.004                            | 8,600                              | 780                | 0.004                           | 0.004                            |       |       |       |
|                              |                       |                    | 3                     | 13,200   | 1,150              | 0.009                           | 0.068                            | 9,400                              | 680                | 0.004                           | 0.005                            | 8,500                              | 770                | 0.004                           | 0.003                            | 8,300                              | 750                | 0.004                           | 0.003                            |       |       |       |
|                              |                       |                    | 4                     | 12,000   | 1,070              | 0.008                           | 0.061                            | 8,500                              | 640                | 0.004                           | 0.005                            | 8,100                              | 730                | 0.004                           | 0.003                            | 7,900                              | 710                | 0.004                           | 0.003                            |       |       |       |
|                              |                       | R0.1<br>R0.2       | 2                     | 15,300   | 1,200              | 0.04                            | 0.27                             | 10,300                             | 710                | 0.03                            | 0.27                             | 8,900                              | 800                | 0.02                            | 0.27                             | 8,600                              | 780                | 0.02                            | 0.26                             |       |       |       |
|                              |                       |                    | 3                     | 13,200   | 1,150              | 0.04                            | 0.27                             | 9,400                              | 680                | 0.03                            | 0.27                             | 8,500                              | 770                | 0.02                            | 0.25                             | 8,300                              | 750                | 0.02                            | 0.24                             |       |       |       |
|                              |                       |                    | 4                     | 12,000   | 1,070              | 0.03                            | 0.24                             | 8,500                              | 640                | 0.02                            | 0.24                             | 8,100                              | 730                | 0.01                            | 0.23                             | 7,900                              | 710                | 0.01                            | 0.22                             |       |       |       |
|                              |                       |                    | 5                     | 11,000   | 960                | 0.03                            | 0.23                             | 7,800                              | 570                | 0.01                            | 0.14                             | 7,700                              | 700                | 0.01                            | 0.21                             | 7,500                              | 680                | 0.01                            | 0.2                              |       |       |       |
|                              |                       | 4015               | 1.5                   | R0.05  | 3                  | 14,800                          | 1,330                            | 0.013                              | 0.135              | 8,900                           | 760                              | 0.005                              | 0.007              | 8,800                           | 870                              | 0.005                              | 0.006              | 8,500                           | 840                              | 0.005 | 0.006 |       |
| 4                            | 13,200                |                    |                       |  | 1,280              | 0.011                           | 0.124                            | 8,600                              | 740                | 0.005                           | 0.007                            | 8,500                              | 840                | 0.005                           | 0.005                            | 8,300                              | 820                | 0.005                           | 0.005                            |       |       |       |
| 6                            | 10,600                |                    |                       |  | 1,210              | 0.01                            | 0.111                            | 8,100                              | 690                | 0.004                           | 0.006                            | 8,000                              | 790                | 0.004                           | 0.005                            | 7,800                              | 770                | 0.004                           | 0.005                            |       |       |       |
| R0.1<br>R0.2<br>R0.3<br>R0.5 | 8                     |                    |                       | 9,300  | 1,020              | 0.008                           | 0.087                            | 7,900                              | 690                | 0.004                           | 0.006                            | 7,700                              | 780                | 0.004                           | 0.004                            | 7,500                              | 760                | 0.004                           | 0.004                            |       |       |       |
|                              | 3                     |                    |                       | 14,800   | 1,330              | 0.05                            | 0.54                             | 8,900                              | 760                | 0.02                            | 0.66                             | 8,800                              | 870                | 0.02                            | 0.41                             | 8,500                              | 840                | 0.02                            | 0.4                              |       |       |       |
|                              | 4                     |                    |                       | 13,200   | 1,280              | 0.04                            | 0.5                              | 8,600                              | 740                | 0.02                            | 0.62                             | 8,500                              | 840                | 0.02                            | 0.39                             | 8,300                              | 820                | 0.02                            | 0.38                             |       |       |       |
|                              | 6                     |                    |                       | 10,600   | 1,210              | 0.04                            | 0.45                             | 8,100                              | 690                | 0.02                            | 0.56                             | 8,000                              | 790                | 0.02                            | 0.35                             | 7,800                              | 770                | 0.02                            | 0.34                             |       |       |       |
|                              | 8                     |                    |                       | 9,300  | 1,020              | 0.03                            | 0.35                             | 7,600                              | 650                | 0.02                            | 0.52                             | 7,500                              | 740                | 0.02                            | 0.31                             | 7,300                              | 720                | 0.02                            | 0.3                              |       |       |       |
|                              | 4020                  |                    |                       | 2  | R0.02              | 4                               | 14,300                           | 1,460                              | 0.01               | 0.118                           | 8,600                            | 860                                | 0.003              | 0.003                           | 8,500                            | 930                                | 0.003              | 0.003                           | 8,300                            | 900   | 0.003 | 0.003 |
|                              |                       |                    |                       |  |                    | 6                               | 12,000                           | 1,200                              | 0.006              | 0.109                           | 8,300                            | 830                                | 0.003              | 0.003                           | 8,100                            | 890                                | 0.003              | 0.003                           | 7,900                            | 860   | 0.003 | 0.003 |
| 8                            |                       | 10,400             | 1,100                 |  |                    | 0.006                           | 0.1                              | 7,900                              | 790                | 0.003                           | 0.003                            | 7,800                              | 840                | 0.003                           | 0.003                            | 7,600                              | 820                | 0.003                           | 0.003                            |       |       |       |
| 10                           |                       | 9,300              | 1,020                 |  |                    | 0.005                           | 0.086                            | 7,500                              | 750                | 0.003                           | 0.003                            | 7,400                              | 800                | 0.003                           | 0.003                            | 7,200                              | 780                | 0.003                           | 0.003                            |       |       |       |
| R0.05                        |                       | 4                  | 14,300                |  | 1,460              | 0.016                           | 0.24                             | 8,600                              | 860                | 0.007                           | 0.01                             | 8,500                              | 930                | 0.007                           | 0.007                            | 8,300                              | 900                | 0.007                           | 0.007                            |       |       |       |
|                              |                       | 6                  | 12,000                |  | 1,200              | 0.015                           | 0.219                            | 8,300                              | 830                | 0.006                           | 0.009                            | 8,100                              | 890                | 0.006                           | 0.007                            | 7,900                              | 860                | 0.006                           | 0.007                            |       |       |       |
|                              |                       | 8                  | 10,400                |  | 1,100              | 0.014                           | 0.197                            | 7,900                              | 790                | 0.006                           | 0.008                            | 7,800                              | 840                | 0.006                           | 0.006                            | 7,600                              | 820                | 0.006                           | 0.006                            |       |       |       |
|                              |                       | 10                 | 9,300                 |  | 1,020              | 0.012                           | 0.165                            | 7,500                              | 750                | 0.005                           | 0.008                            | 7,400                              | 800                | 0.005                           | 0.006                            | 7,200                              | 780                | 0.005                           | 0.006                            |       |       |       |
| R0.1                         |                       | 4                  | 14,300                |  | 1,460              | 0.033                           | 0.405                            | 8,600                              | 860                | 0.013                           | 0.18                             | 8,500                              | 930                | 0.013                           | 0.134                            | 8,300                              | 900                | 0.013                           | 0.13                             |       |       |       |
|                              |                       | 6                  | 12,000                |  | 1,200              | 0.03                            | 0.365                            | 8,300                              | 830                | 0.012                           | 0.166                            | 8,100                              | 890                | 0.012                           | 0.124                            | 7,900                              | 860                | 0.012                           | 0.12                             |       |       |       |
|                              | 8                     | 10,400             | 1,100                 | 0.028  | 0.324              | 7,900                           | 790                              | 0.011                              | 0.152              | 7,800                           | 840                              | 0.011                              | 0.113              | 7,600                           | 820                              | 0.011                              | 0.11               |                                 |                                  |       |       |       |
|                              | 10                    | 9,300              | 1,020                 | 0.024  | 0.263              | 7,500                           | 750                              | 0.01                               | 0.138              | 7,400                           | 800                              | 0.01                               | 0.103              | 7,200                           | 780                              | 0.01                               | 0.1                |                                 |                                  |       |       |       |
| R0.2<br>R0.3<br>R0.5         | 4                     | 14,300             | 1,460                 | 0.07   | 0.81               | 8,600                           | 860                              | 0.03                               | 0.9                | 8,500                           | 930                              | 0.03                               | 0.54               | 8,300                           | 900                              | 0.03                               | 0.52               |                                 |                                  |       |       |       |
|                              | 6                     | 12,000             | 1,200                 | 0.06   | 0.73               | 8,300                           | 830                              | 0.02                               | 0.83               | 8,100                           | 890                              | 0.02                               | 0.49               | 7,900                           | 860                              | 0.02                               | 0.48               |                                 |                                  |       |       |       |
|                              | 8                     | 10,400             | 1,100                 | 0.06   | 0.65               | 7,900                           | 790                              | 0.02                               | 0.76               | 7,800                           | 840                              | 0.02                               | 0.45               | 7,600                           | 820                              | 0.02                               | 0.44               |                                 |                                  |       |       |       |
|                              | 10                    | 9,300              | 1,020                 | 0.05   | 0.53               | 7,500                           | 750                              | 0.02                               | 0.69               | 7,400                           | 800                              | 0.02                               | 0.41               | 7,200                           | 780                              | 0.02                               | 0.4                |                                 |                                  |       |       |       |

4 Flutes

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Square
- Long Neck Square
- Radius
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

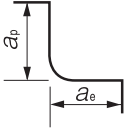


Milling Conditions for HGLRS

| WORK MATERIAL              |                       |                            |                       | PREHARDENED STEELS / HARDENED STEELS NAK / STAVAX (~55HRC) |                    |                                 |                                  | HARDENED STEELS SKD11 (55~62HRC)   |                    |                                 |                                  | HARDENED STEELS HAP10 (62~66HRC)   |                    |                                 |                                  | HARDENED STEELS HAP72 (66~70HRC)   |                    |                                 |                                  |       |       |
|----------------------------|-----------------------|----------------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|-------|-------|
| Model Number               | Outside Diameter (mm) | Corner Radius (mm)         | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |       |       |
| 4030                       | 3                     | R0.05                      | 4                     | 14,000   | 2,640              | 0.02                            | 0.18                             | 8,900                              | 1,140              | 0.011                           | 0.013                            | 8,700                              | 1,110              | 0.011                           | 0.012                            | 8,400                              | 1,080              | 0.011                           | 0.012                            |       |       |
|                            |                       |                            | 6                     | 13,300   | 2,500              | 0.019                           | 0.18                             | 8,600                              | 1,110              | 0.01                            | 0.012                            | 8,400                              | 1,080              | 0.01                            | 0.011                            | 8,200                              | 1,050              | 0.01                            | 0.011                            |       |       |
|                            |                       |                            | 8                     | 11,800   | 2,200              | 0.018                           | 0.175                            | 8,400                              | 1,080              | 0.01                            | 0.012                            | 8,100                              | 1,050              | 0.01                            | 0.011                            | 7,900                              | 1,020              | 0.01                            | 0.011                            |       |       |
|                            |                       |                            | 10                    | 10,500   | 2,090              | 0.015                           | 0.175                            | 8,100                              | 1,050              | 0.009                           | 0.011                            | 7,900                              | 1,020              | 0.009                           | 0.01                             | 7,700                              | 990                | 0.009                           | 0.01                             |       |       |
|                            |                       |                            | 12                    | 10,000   | 1,950              | 0.013                           | 0.168                            | 7,900                              | 1,010              | 0.009                           | 0.01                             | 7,700                              | 990                | 0.009                           | 0.01                             | 7,500                              | 960                | 0.009                           | 0.009                            |       |       |
|                            |                       |                            | 16                    | 8,800  | 1,600              | 0.01                            | 0.158                            | 7,400                              | 950                | 0.008                           | 0.01                             | 7,200                              | 930                | 0.008                           | 0.009                            | 7,000                              | 900                | 0.008                           | 0.008                            |       |       |
|                            |                       | R0.1                       | 4                     | 14,000   | 2,640              | 0.04                            | 0.36                             | 8,900                              | 1,140              | 0.021                           | 0.291                            | 8,700                              | 1,110              | 0.022                           | 0.216                            | 8,400                              | 1,080              | 0.021                           | 0.21                             |       |       |
|                            |                       |                            | 6                     | 13,300   | 2,500              | 0.038                           | 0.36                             | 8,600                              | 1,110              | 0.02                            | 0.277                            | 8,400                              | 1,080              | 0.021                           | 0.206                            | 8,200                              | 1,050              | 0.02                            | 0.2                              |       |       |
|                            |                       |                            | 8                     | 11,800   | 2,200              | 0.035                           | 0.35                             | 8,400                              | 1,080              | 0.019                           | 0.263                            | 8,100                              | 1,050              | 0.02                            | 0.196                            | 7,900                              | 1,020              | 0.019                           | 0.19                             |       |       |
|                            |                       |                            | 10                    | 10,500   | 2,090              | 0.03                            | 0.35                             | 8,100                              | 1,050              | 0.018                           | 0.249                            | 7,900                              | 1,020              | 0.019                           | 0.185                            | 7,700                              | 990                | 0.018                           | 0.18                             |       |       |
|                            |                       |                            | 12                    | 10,000   | 1,950              | 0.026                           | 0.335                            | 7,900                              | 1,010              | 0.017                           | 0.235                            | 7,700                              | 990                | 0.018                           | 0.175                            | 7,500                              | 960                | 0.017                           | 0.17                             |       |       |
|                            |                       |                            | 16                    | 8,800  | 1,600              | 0.02                            | 0.315                            | 7,400                              | 950                | 0.015                           | 0.208                            | 7,200                              | 930                | 0.015                           | 0.155                            | 7,000                              | 900                | 0.015                           | 0.15                             |       |       |
|                            |                       | R0.2<br>R0.3<br>R0.5<br>R1 | 4                     | 14,000   | 2,640              | 0.08                            | 0.72                             | 8,900                              | 1,140              | 0.04                            | 1.45                             | 8,700                              | 1,110              | 0.04                            | 0.87                             | 8,400                              | 1,080              | 0.04                            | 0.84                             |       |       |
|                            |                       |                            | 6                     | 13,300   | 2,500              | 0.08                            | 0.72                             | 8,600                              | 1,110              | 0.04                            | 1.38                             | 8,400                              | 1,080              | 0.04                            | 0.82                             | 8,200                              | 1,050              | 0.04                            | 0.8                              |       |       |
|                            |                       |                            | 8                     | 11,800   | 2,200              | 0.07                            | 0.7                              | 8,400                              | 1,080              | 0.04                            | 1.31                             | 8,100                              | 1,050              | 0.04                            | 0.78                             | 7,900                              | 1,020              | 0.04                            | 0.76                             |       |       |
|                            |                       |                            | 10                    | 10,500   | 2,090              | 0.06                            | 0.7                              | 8,100                              | 1,050              | 0.04                            | 1.25                             | 7,900                              | 1,020              | 0.04                            | 0.74                             | 7,700                              | 990                | 0.04                            | 0.72                             |       |       |
|                            |                       |                            | 12                    | 10,000   | 1,950              | 0.05                            | 0.67                             | 7,900                              | 1,010              | 0.03                            | 1.18                             | 7,700                              | 990                | 0.04                            | 0.7                              | 7,500                              | 960                | 0.03                            | 0.68                             |       |       |
|                            |                       |                            | 16                    | 8,800  | 1,600              | 0.04                            | 0.63                             | 7,400                              | 950                | 0.03                            | 1                                | 7,200                              | 930                | 0.03                            | 0.62                             | 7,000                              | 900                | 0.03                            | 0.6                              |       |       |
|                            |                       | 4040                       | 4                     | R0.05  | 8                  | 8,500                           | 1,420                            | 0.026                              | 0.338              | 6,200                           | 1,130                            | 0.013                              | 0.016              | 6,100                           | 1,090                            | 0.013                              | 0.015              | 5,900                           | 1,060                            | 0.013 | 0.014 |
|                            |                       |                            |                       |  | 12                 | 7,600                           | 1,390                            | 0.023                              | 0.288              | 5,900                           | 1,080                            | 0.012                              | 0.014              | 5,800                           | 1,040                            | 0.012                              | 0.014              | 5,600                           | 1,010                            | 0.012 | 0.013 |
|                            |                       |                            |                       |  | 16                 | 6,600                           | 1,330                            | 0.018                              | 0.25               | 5,700                           | 1,030                            | 0.011                              | 0.013              | 5,600                           | 1,000                            | 0.011                              | 0.013              | 5,400                           | 970                              | 0.011 | 0.012 |
|                            |                       |                            |                       |  | 20                 | 5,800                           | 1,260                            | 0.015                              | 0.225              | 5,400                           | 980                              | 0.01                               | 0.012              | 5,300                           | 950                              | 0.01                               | 0.011              | 5,100                           | 920                              | 0.01  | 0.011 |
|                            |                       |                            |                       | R0.1   | 8                  | 8,500                           | 1,420                            | 0.052                              | 0.675              | 6,200                           | 1,130                            | 0.026                              | 0.36               | 6,100                           | 1,090                            | 0.027                              | 0.268              | 5,900                           | 1,060                            | 0.026 | 0.26  |
|                            |                       |                            |                       |  | 12                 | 7,600                           | 1,390                            | 0.046                              | 0.575              | 5,900                           | 1,080                            | 0.024                              | 0.332              | 5,800                           | 1,040                            | 0.025                              | 0.247              | 5,600                           | 1,010                            | 0.024 | 0.24  |
| 16                         | 6,600                 |                            |                       |  | 1,330              | 0.036                           | 0.5                              | 5,700                              | 1,030              | 0.022                           | 0.304                            | 5,600                              | 1,000              | 0.023                           | 0.227                            | 5,400                              | 970                | 0.022                           | 0.22                             |       |       |
| 20                         | 5,800                 |                            |                       |  | 1,260              | 0.03                            | 0.45                             | 5,400                              | 980                | 0.02                            | 0.277                            | 5,300                              | 950                | 0.021                           | 0.206                            | 5,100                              | 920                | 0.02                            | 0.2                              |       |       |
| R0.2<br>R0.3<br>R0.5<br>R1 | 8                     |                            |                       | 8,500  | 1,420              | 0.1                             | 1.35                             | 6,200                              | 1,130              | 0.05                            | 1.8                              | 6,100                              | 1,090              | 0.05                            | 1.07                             | 5,900                              | 1,060              | 0.05                            | 1.04                             |       |       |
|                            | 12                    |                            |                       | 7,600  | 1,390              | 0.09                            | 1.15                             | 5,900                              | 1,080              | 0.05                            | 1.66                             | 5,800                              | 1,040              | 0.05                            | 0.99                             | 5,600                              | 1,010              | 0.05                            | 0.96                             |       |       |
|                            | 16                    |                            |                       | 6,600  | 1,330              | 0.07                            | 1                                | 5,700                              | 1,030              | 0.04                            | 1.52                             | 5,600                              | 1,000              | 0.05                            | 0.91                             | 5,400                              | 970                | 0.04                            | 0.88                             |       |       |
|                            | 20                    |                            |                       | 5,800  | 1,260              | 0.06                            | 0.9                              | 5,400                              | 980                | 0.04                            | 1.38                             | 5,300                              | 950                | 0.04                            | 0.82                             | 5,100                              | 920                | 0.04                            | 0.8                              |       |       |
| 4060                       | 6                     | R0.1                       | 12                    | 4,700  | 1,360              | 0.1                             | 0.675                            | 3,900                              | 1,180              | 0.033                           | 0.676                            | 3,800                              | 1,150              | 0.033                           | 0.502                            | 3,700                              | 1,120              | 0.033                           | 0.488                            |       |       |
|                            |                       |                            | 16                    | 4,000  | 1,150              | 0.095                           | 0.665                            | 3,800                              | 1,150              | 0.031                           | 0.641                            | 3,700                              | 1,110              | 0.032                           | 0.476                            | 3,600                              | 1,080              | 0.031                           | 0.463                            |       |       |
|                            |                       |                            | 20                    | 3,500  | 1,000              | 0.09                            | 0.655                            | 3,700                              | 1,120              | 0.029                           | 0.607                            | 3,600                              | 1,080              | 0.03                            | 0.451                            | 3,500                              | 1,050              | 0.029                           | 0.438                            |       |       |
|                            |                       |                            | 24                    | 3,100  | 860                | 0.085                           | 0.645                            | 3,600                              | 1,080              | 0.028                           | 0.572                            | 3,500                              | 1,050              | 0.028                           | 0.425                            | 3,400                              | 1,020              | 0.028                           | 0.413                            |       |       |
|                            |                       |                            | 30                    | 2,600  | 740                | 0.079                           | 0.63                             | 3,400                              | 1,030              | 0.025                           | 0.52                             | 3,300                              | 1,000              | 0.026                           | 0.386                            | 3,200                              | 970                | 0.025                           | 0.375                            |       |       |
|                            |                       | R0.2<br>R0.3<br>R0.5<br>R1 | 12                    | 4,700  | 1,360              | 0.2                             | 1.35                             | 3,900                              | 1,180              | 0.07                            | 3.38                             | 3,800                              | 1,150              | 0.07                            | 2                                | 3,700                              | 1,120              | 0.07                            | 1.95                             |       |       |
|                            |                       |                            | 16                    | 4,000  | 1,150              | 0.19                            | 1.33                             | 3,800                              | 1,150              | 0.06                            | 3.21                             | 3,700                              | 1,110              | 0.06                            | 1.9                              | 3,600                              | 1,080              | 0.06                            | 1.85                             |       |       |
|                            |                       |                            | 20                    | 3,500  | 1,000              | 0.18                            | 1.31                             | 3,700                              | 1,120              | 0.06                            | 3                                | 3,600                              | 1,080              | 0.06                            | 1.8                              | 3,500                              | 1,050              | 0.06                            | 1.75                             |       |       |
|                            |                       |                            | 24                    | 3,100  | 860                | 0.17                            | 1.29                             | 3,600                              | 1,080              | 0.06                            | 2.86                             | 3,500                              | 1,050              | 0.06                            | 1.7                              | 3,400                              | 1,020              | 0.06                            | 1.65                             |       |       |
|                            |                       |                            | 30                    | 2,600  | 740                | 0.16                            | 1.26                             | 3,400                              | 1,030              | 0.05                            | 2.6                              | 3,300                              | 1,000              | 0.05                            | 1.55                             | 3,200                              | 970                | 0.05                            | 1.5                              |       |       |



- Note:
- Decrease the feed rate more than 50% from the milling parameters when slot milling.
  - Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when chattering and red-hot occur.
  - Every coolant offers stable milling.



4 Flutes

∅3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Square  
Long Neck  
Square

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.2 \sim \phi 6$

# HLRS4000



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●      | ●      | ○      |        |           |                 |          | ○      |          |                       | ○               | ○                     |                  |                                       |

Total 381 models

Unit (mm)

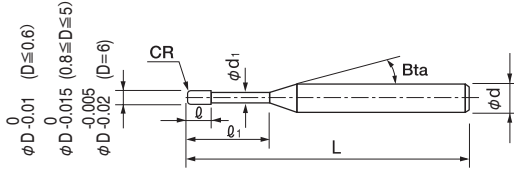
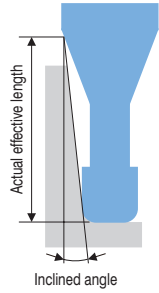
| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| HLRS 4002-002-003 | 0.2                       | R0.02            | 0.3                       | 0.12                 | 0.185                    | 16°                   | 50               | 4                       | 14,100                   |
| HLRS 4002-002-005 |                           |                  | 0.5                       |                      |                          |                       | 50               | 4                       | 14,100                   |
| HLRS 4002-002-010 |                           |                  | 1                         |                      |                          |                       | 50               | 4                       | 14,100                   |
| HLRS 4002-002-015 |                           |                  | 1.5                       |                      |                          |                       | 50               | 4                       | 16,590                   |
| HLRS 4002-002-020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 18,150                   |
| HLRS 4002-005-003 |                           |                  | R0.05                     |                      |                          |                       | 0.3              | 50                      | 4                        |
| HLRS 4003-002-003 | 0.3                       | R0.02            | 0.3                       | 0.18                 | 0.28                     | 16°                   | 50               | 4                       | 14,100                   |
| HLRS 4003-002-005 |                           |                  | 0.5                       |                      |                          |                       | 50               | 4                       | 14,100                   |
| HLRS 4003-002-010 |                           |                  | 1                         |                      |                          |                       | 50               | 4                       | 14,100                   |
| HLRS 4003-002-015 |                           |                  | 1.5                       |                      |                          |                       | 50               | 4                       | 14,100                   |
| HLRS 4003-002-020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 14,100                   |
| HLRS 4003-005-003 |                           |                  | R0.05                     |                      |                          |                       | 0.3              | 50                      | 4                        |
| HLRS 4003-005-005 |                           | 0.5              | 50                        | 4                    | 14,100                   |                       |                  |                         |                          |
| HLRS 4004-002-005 | 0.4                       | R0.02            | 0.5                       | 0.24                 | 0.385                    | 16°                   | 50               | 4                       | 9,050                    |
| HLRS 4004-002-010 |                           |                  | 1                         |                      |                          |                       | 50               | 4                       | 9,050                    |
| HLRS 4004-002-020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 9,050                    |
| HLRS 4004-005-005 |                           | R0.05            | 0.5                       |                      |                          |                       | 50               | 4                       | 9,050                    |
| HLRS 4004-005-010 |                           |                  | 1                         |                      |                          |                       | 50               | 4                       | 9,050                    |
| HLRS 4004-005-015 |                           |                  | 1.5                       |                      |                          |                       | 50               | 4                       | 9,050                    |
| HLRS 4004-005-020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 9,050                    |
| HLRS 4004-01-010  |                           | R0.1             | 1                         |                      |                          |                       | 50               | 4                       | 9,050                    |
| HLRS 4004-01-020  |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 9,050                    |

Next Page →

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Features

Long Neck Radius design for high efficiency and high quality milling.  
 The rigid tool geometry offers longer tool life when milling Hard Materials.  
 HARDMAX coat is adopted which maintains heat resistance, toughness and lubricity at a high level.  
 Both dry and wet coolant offer stable and long tool life.  
 Refer to page 324 for 2 flute HLRS.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |      |       |      |      |      |
|-------------------|---------------------------|------------------|------------------------|-------------------------------------|------|-------|------|------|------|
|                   |                           |                  |                        | 30'                                 | 1°   | 1°30' | 2°   | 3°   |      |
| HLRS 4002-002-003 | 0.2                       | RO.02            | 0.3                    | 0.39                                | 0.41 | 0.44  | 0.46 | 0.51 |      |
| HLRS 4002-002-005 |                           |                  | 0.5                    | 0.60                                | 0.63 | 0.67  | 0.70 | 0.75 |      |
| HLRS 4002-002-010 |                           |                  | 1                      | 1.13                                | 1.18 | 1.22  | 1.27 | 1.36 |      |
| HLRS 4002-002-015 |                           |                  | 1.5                    | 1.65                                | 1.71 | 1.77  | 1.84 | 1.98 |      |
| HLRS 4002-002-020 |                           |                  | 2                      | 2.17                                | 2.25 | 2.32  | 2.41 | 2.59 |      |
| HLRS 4002-005-003 | 0.3                       | RO.05            | 0.3                    | 0.39                                | 0.41 | 0.43  | 0.46 | 0.50 |      |
| HLRS 4003-002-003 |                           |                  | 0.3                    | 0.41                                | 0.43 | 0.46  | 0.48 | 0.52 |      |
| HLRS 4003-002-005 |                           | RO.02            | 0.5                    | 0.62                                | 0.65 | 0.68  | 0.71 | 0.77 |      |
| HLRS 4003-002-010 |                           |                  | 1                      | 1.15                                | 1.19 | 1.24  | 1.28 | 1.38 |      |
| HLRS 4003-002-015 |                           |                  | 1.5                    | 1.67                                | 1.73 | 1.79  | 1.85 | 1.99 |      |
| HLRS 4003-002-020 |                           |                  | 2                      | 2.19                                | 2.26 | 2.34  | 2.42 | 2.60 |      |
| HLRS 4003-005-003 |                           | RO.05            | 0.3                    | 0.41                                | 0.43 | 0.45  | 0.47 | 0.52 |      |
| HLRS 4003-005-005 |                           |                  | 0.5                    | 0.62                                | 0.65 | 0.68  | 0.71 | 0.76 |      |
| HLRS 4004-002-005 |                           | 0.4              | RO.02                  | 0.5                                 | 0.62 | 0.65  | 0.68 | 0.71 | 0.77 |
| HLRS 4004-002-010 |                           |                  |                        | 1                                   | 1.15 | 1.19  | 1.24 | 1.28 | 1.38 |
| HLRS 4004-002-020 | 2                         |                  |                        | 2.17                                | 2.25 | 2.33  | 2.41 | 2.59 |      |
| HLRS 4004-005-005 | RO.05                     |                  | 0.5                    | 0.62                                | 0.65 | 0.68  | 0.71 | 0.76 |      |
| HLRS 4004-005-010 |                           |                  | 1                      | 1.14                                | 1.19 | 1.23  | 1.28 | 1.37 |      |
| HLRS 4004-005-015 |                           |                  | 1.5                    | 1.65                                | 1.72 | 1.77  | 1.84 | 1.97 |      |
| HLRS 4004-005-020 |                           |                  | 2                      | 2.17                                | 2.25 | 2.32  | 2.41 | 2.59 |      |
| HLRS 4004-01-010  | RO.1                      |                  | 1                      | 1.14                                | 1.19 | 1.23  | 1.27 | 1.36 |      |
| HLRS 4004-01-020  |                           |                  | 2                      | 2.17                                | 2.25 | 2.32  | 2.40 | 2.57 |      |

Next Page →

4 Flutes

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |       |
|-------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------|
| HLRS 4005-002-010 | 0.5                       | R0.02            | 1                         | 0.3                  | 0.485                    | 16°                   | 50               | 4                       | 7,370                    |       |
| HLRS 4005-002-020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 7,370                    |       |
| HLRS 4005-005-010 |                           | R0.05            | 1                         |                      |                          |                       | 50               | 4                       | 7,370                    |       |
| HLRS 4005-005-020 |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 7,370                    |       |
| HLRS 4005-01-010  |                           | R0.1             | 1                         |                      |                          |                       | 50               | 4                       | 7,370                    |       |
| HLRS 4005-01-020  |                           |                  | 2                         |                      |                          |                       | 50               | 4                       | 7,370                    |       |
| HLRS 4006-005-020 | 0.6                       | R0.05            | 2                         | 0.36                 | 0.585                    | 16°                   | 50               | 4                       | 7,370                    |       |
| HLRS 4006-005-040 |                           |                  | 4                         |                      |                          |                       | 50               | 4                       | 7,370                    |       |
| HLRS 4006-01-020  |                           | R0.1             | 2                         |                      |                          |                       | 50               | 4                       | 7,370                    |       |
| HLRS 4006-01-040  |                           |                  | 4                         |                      |                          |                       | 50               | 4                       | 7,370                    |       |
| HLRS 4008-002-020 | 0.8                       | R0.02            | 2                         | 0.48                 | 0.78                     | 16°                   | 50               | 4                       | 8,100                    |       |
| HLRS 4008-002-030 |                           |                  | 3                         |                      |                          |                       | 50               | 4                       | 8,100                    |       |
| HLRS 4008-002-040 |                           |                  | 4                         |                      |                          |                       | 50               | 4                       | 8,400                    |       |
| HLRS 4008-002-060 |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 8,400                    |       |
| HLRS 4008-002-080 |                           |                  | 8                         |                      |                          |                       | 50               | 4                       | 8,400                    |       |
| HLRS 4008-005-020 |                           |                  | R0.05                     |                      |                          |                       | 2                | 50                      | 4                        | 8,100 |
| HLRS 4008-005-030 |                           | 3                |                           |                      |                          |                       | 50               | 4                       | 8,100                    |       |
| HLRS 4008-005-040 |                           | 4                |                           |                      |                          |                       | 50               | 4                       | 8,400                    |       |
| HLRS 4008-005-060 |                           | 6                |                           |                      |                          |                       | 50               | 4                       | 8,400                    |       |
| HLRS 4008-01-020  |                           | R0.1             |                           |                      |                          |                       | 2                | 50                      | 4                        | 8,100 |
| HLRS 4008-01-030  |                           |                  |                           |                      |                          |                       | 3                | 50                      | 4                        | 8,100 |
| HLRS 4008-01-040  |                           |                  | 4                         |                      |                          |                       | 50               | 4                       | 8,400                    |       |
| HLRS 4008-01-060  |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 8,400                    |       |
| HLRS 4008-02-020  |                           |                  | R0.2                      |                      |                          |                       | 2                | 50                      | 4                        | 8,100 |
| HLRS 4008-02-030  |                           |                  |                           |                      |                          |                       | 3                | 50                      | 4                        | 8,100 |
| HLRS 4008-02-040  |                           | 4                |                           |                      |                          |                       | 50               | 4                       | 8,400                    |       |
| HLRS 4008-02-060  |                           | 6                |                           |                      |                          |                       | 50               | 4                       | 8,400                    |       |
| HLRS 4010-002-020 |                           | 1                |                           |                      |                          |                       | R0.02            | 2                       | 0.8                      | 0.95  |
| HLRS 4010-002-030 | 3                         |                  |                           | 50                   | 4                        | 7,400                 |                  |                         |                          |       |
| HLRS 4010-002-040 | 4                         |                  | 50                        | 4                    | 7,400                    |                       |                  |                         |                          |       |
| HLRS 4010-002-050 | 5                         |                  | 50                        | 4                    | 8,100                    |                       |                  |                         |                          |       |
| HLRS 4010-002-060 | 6                         |                  | 50                        | 4                    | 8,100                    |                       |                  |                         |                          |       |
| HLRS 4010-002-080 | 8                         |                  | 50                        | 4                    | 8,100                    |                       |                  |                         |                          |       |
| HLRS 4010-002-100 | 10                        |                  | 50                        | 4                    | 8,100                    |                       |                  |                         |                          |       |
| HLRS 4010-002-120 | 12                        |                  | 55                        | 4                    | 8,100                    |                       |                  |                         |                          |       |
| HLRS 4010-005-020 | R0.05                     |                  | 2                         | 50                   | 4                        | 7,400                 |                  |                         |                          |       |
| HLRS 4010-005-030 |                           |                  | 3                         | 50                   | 4                        | 7,400                 |                  |                         |                          |       |
| HLRS 4010-005-040 |                           |                  | 4                         | 50                   | 4                        | 7,400                 |                  |                         |                          |       |
| HLRS 4010-005-040 |                           |                  | 4                         | 50                   | 4                        | 7,400                 |                  |                         |                          |       |

- $\phi 3\text{mm}$  Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |       |       |       |       |      |
|-------------------|---------------------------|------------------|------------------------|-------------------------------------|-------|-------|-------|-------|------|
|                   |                           |                  |                        | 30'                                 | 1°    | 1°30' | 2°    | 3°    |      |
| HLRS 4005-002-010 | 0.5                       | RO.02            | 1                      | 1.15                                | 1.19  | 1.24  | 1.28  | 1.38  |      |
| HLRS 4005-002-020 |                           |                  | 2                      | 2.17                                | 2.25  | 2.33  | 2.41  | 2.59  |      |
| HLRS 4005-005-010 |                           | RO.05            | 1                      | 1.14                                | 1.19  | 1.23  | 1.28  | 1.37  |      |
| HLRS 4005-005-020 |                           |                  | 2                      | 2.17                                | 2.25  | 2.32  | 2.41  | 2.59  |      |
| HLRS 4005-01-010  |                           | RO.1             | 1                      | 1.14                                | 1.19  | 1.23  | 1.27  | 1.36  |      |
| HLRS 4005-01-020  |                           |                  | 2                      | 2.17                                | 2.25  | 2.32  | 2.40  | 2.57  |      |
| HLRS 4006-005-020 | 0.6                       | RO.05            | 2                      | 2.17                                | 2.25  | 2.32  | 2.41  | 2.59  |      |
| HLRS 4006-005-040 |                           |                  | 4                      | 4.24                                | 4.38  | 4.53  | 4.68  | 5.03  |      |
| HLRS 4006-01-020  |                           | RO.1             | 2                      | 2.17                                | 2.25  | 2.32  | 2.40  | 2.57  |      |
| HLRS 4006-01-040  |                           |                  | 4                      | 4.24                                | 4.38  | 4.52  | 4.68  | 5.02  |      |
| HLRS 4008-002-020 | 0.8                       | RO.02            | 2                      | 2.51                                | 2.70  | 2.87  | 3.02  | 3.29  |      |
| HLRS 4008-002-030 |                           |                  | 3                      | 3.59                                | 3.82  | 4.02  | 4.19  | 4.51  |      |
| HLRS 4008-002-040 |                           |                  | 4                      | 4.66                                | 4.92  | 5.14  | 5.34  | 5.74  |      |
| HLRS 4008-002-060 |                           |                  | 6                      | 6.78                                | 7.10  | 7.36  | 7.61  | 8.19  |      |
| HLRS 4008-002-080 |                           |                  | 8                      | 8.88                                | 9.25  | 9.56  | 9.89  | 10.63 |      |
| HLRS 4008-005-020 |                           |                  | RO.05                  | 2                                   | 2.51  | 2.70  | 2.86  | 3.01  | 3.28 |
| HLRS 4008-005-030 |                           | 3                |                        | 3.59                                | 3.82  | 4.01  | 4.19  | 4.51  |      |
| HLRS 4008-005-040 |                           | 4                |                        | 4.66                                | 4.92  | 5.14  | 5.33  | 5.73  |      |
| HLRS 4008-005-060 |                           | 6                |                        | 6.77                                | 7.09  | 7.35  | 7.61  | 8.18  |      |
| HLRS 4008-01-020  |                           | RO.1             |                        | 2                                   | 2.51  | 2.69  | 2.86  | 3.00  | 3.27 |
| HLRS 4008-01-030  |                           |                  |                        | 3                                   | 3.58  | 3.81  | 4.01  | 4.18  | 4.50 |
| HLRS 4008-01-040  |                           |                  | 4                      | 4.65                                | 4.92  | 5.13  | 5.33  | 5.72  |      |
| HLRS 4008-01-060  |                           |                  | 6                      | 6.77                                | 7.09  | 7.35  | 7.60  | 8.17  |      |
| HLRS 4008-02-020  |                           |                  | RO.2                   | 2                                   | 2.49  | 2.68  | 2.84  | 2.98  | 3.25 |
| HLRS 4008-02-030  |                           |                  |                        | 3                                   | 3.57  | 3.80  | 3.99  | 4.16  | 4.47 |
| HLRS 4008-02-040  |                           | 4                |                        | 4.64                                | 4.90  | 5.12  | 5.31  | 5.70  |      |
| HLRS 4008-02-060  |                           | 6                |                        | 6.76                                | 7.08  | 7.34  | 7.59  | 8.14  |      |
| HLRS 4010-002-020 |                           | 1                |                        | RO.02                               | 2     | 2.57  | 2.75  | 2.90  | 3.05 |
| HLRS 4010-002-030 | 3                         |                  |                        |                                     | 3.64  | 3.86  | 4.05  | 4.22  | 4.54 |
| HLRS 4010-002-040 | 4                         |                  | 4.70                   |                                     | 4.96  | 5.17  | 5.36  | 5.76  |      |
| HLRS 4010-002-050 | 5                         |                  | 5.76                   |                                     | 6.04  | 6.28  | 6.50  | 6.99  |      |
| HLRS 4010-002-060 | 6                         |                  | 6.81                   |                                     | 7.12  | 7.38  | 7.64  | 8.21  |      |
| HLRS 4010-002-080 | 8                         |                  | 8.91                   |                                     | 9.27  | 9.58  | 9.92  | 10.66 |      |
| HLRS 4010-002-100 | 10                        |                  | 11.00                  |                                     | 11.40 | 11.78 | 12.19 | 13.11 |      |
| HLRS 4010-002-120 | 12                        |                  | 13.08                  |                                     | 13.53 | 13.98 | 14.47 | 15.55 |      |
| HLRS 4010-005-020 | RO.05                     |                  | 2                      | 2.56                                | 2.74  | 2.90  | 3.05  | 3.31  |      |
| HLRS 4010-005-030 |                           |                  | 3                      | 3.63                                | 3.85  | 4.04  | 4.21  | 4.53  |      |
| HLRS 4010-005-040 |                           |                  | 4                      | 4.70                                | 4.95  | 5.17  | 5.36  | 5.76  |      |

4 Flutes

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |       |
|-------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------|
| HLRS 4010-005-050 | 1                         | RO.05            | 5                         | 0.8                  | 0.95                     | 16°                   | 50               | 4                       | 8,100                    |       |
| HLRS 4010-005-060 |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 8,100                    |       |
| HLRS 4010-005-080 |                           |                  | 8                         |                      |                          |                       | 50               | 4                       | 8,100                    |       |
| HLRS 4010-005-100 |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 8,100                    |       |
| HLRS 4010-005-120 |                           |                  | 12                        |                      |                          |                       | 55               | 4                       | 8,100                    |       |
| HLRS 4010-01-020  |                           | RO.1             | 2                         |                      |                          |                       | 50               | 4                       | 7,400                    |       |
| HLRS 4010-01-030  |                           |                  | 3                         |                      |                          |                       | 50               | 4                       | 7,400                    |       |
| HLRS 4010-01-040  |                           |                  | 4                         |                      |                          |                       | 50               | 4                       | 7,400                    |       |
| HLRS 4010-01-050  |                           |                  | 5                         |                      |                          |                       | 50               | 4                       | 8,100                    |       |
| HLRS 4010-01-060  |                           |                  | 6                         |                      |                          |                       | 50               | 4                       | 8,100                    |       |
| HLRS 4010-01-080  |                           |                  | 8                         |                      |                          |                       | 50               | 4                       | 8,100                    |       |
| HLRS 4010-01-100  |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 8,100                    |       |
| HLRS 4010-01-120  |                           |                  | 12                        |                      |                          |                       | 55               | 4                       | 8,100                    |       |
| HLRS 4010-02-020  |                           |                  | RO.2                      |                      |                          |                       | 2                | 50                      | 4                        | 7,400 |
| HLRS 4010-02-030  |                           |                  |                           |                      |                          |                       | 3                | 50                      | 4                        | 7,400 |
| HLRS 4010-02-040  |                           |                  |                           |                      |                          |                       | 4                | 50                      | 4                        | 7,400 |
| HLRS 4010-02-050  |                           |                  |                           |                      |                          |                       | 5                | 50                      | 4                        | 8,100 |
| HLRS 4010-02-060  |                           | 6                |                           |                      |                          |                       | 50               | 4                       | 8,100                    |       |
| HLRS 4010-02-080  |                           | 8                |                           |                      |                          |                       | 50               | 4                       | 8,100                    |       |
| HLRS 4010-02-100  |                           | 10               |                           |                      |                          |                       | 50               | 4                       | 8,100                    |       |
| HLRS 4010-02-120  |                           | 12               |                           |                      |                          |                       | 55               | 4                       | 8,100                    |       |
| HLRS 4010-03-020  |                           | RO.3             |                           |                      |                          |                       | 2                | 50                      | 4                        | 7,400 |
| HLRS 4010-03-030  |                           |                  |                           |                      |                          |                       | 3                | 50                      | 4                        | 7,400 |
| HLRS 4010-03-040  |                           |                  |                           |                      |                          |                       | 4                | 50                      | 4                        | 7,400 |
| HLRS 4010-03-050  | 5                         |                  |                           | 50                   | 4                        | 8,100                 |                  |                         |                          |       |
| HLRS 4010-03-060  | 6                         |                  | 50                        | 4                    | 8,100                    |                       |                  |                         |                          |       |
| HLRS 4010-03-080  | 8                         |                  | 50                        | 4                    | 8,100                    |                       |                  |                         |                          |       |
| HLRS 4010-03-100  | 10                        |                  | 50                        | 4                    | 8,100                    |                       |                  |                         |                          |       |
| HLRS 4010-03-120  | 12                        |                  | 55                        | 4                    | 8,100                    |                       |                  |                         |                          |       |
| HLRS 4010-03-160  | 16                        |                  | 60                        | 4                    | 10,740                   |                       |                  |                         |                          |       |
| HLRS 4012-01-040  | 1.2                       |                  | RO.1                      | 4                    | 0.96                     | 1.14                  | 16°              | 50                      | 4                        | 8,400 |
| HLRS 4012-01-060  |                           |                  |                           | 6                    |                          |                       |                  | 50                      | 4                        | 8,400 |
| HLRS 4012-01-100  |                           |                  |                           | 10                   |                          |                       |                  | 50                      | 4                        | 8,400 |
| HLRS 4012-02-040  |                           | RO.2             | 4                         | 50                   |                          |                       |                  | 4                       | 8,400                    |       |
| HLRS 4012-02-060  |                           |                  | 6                         | 50                   |                          |                       |                  | 4                       | 8,400                    |       |
| HLRS 4012-02-100  |                           |                  | 10                        | 50                   |                          |                       |                  | 4                       | 8,400                    |       |
| HLRS 4012-03-040  |                           | RO.3             | 4                         | 50                   |                          |                       |                  | 4                       | 8,400                    |       |
| HLRS 4012-03-060  |                           |                  | 6                         | 50                   |                          |                       |                  | 4                       | 8,400                    |       |
| HLRS 4012-03-100  |                           |                  | 10                        | 50                   |                          |                       |                  | 4                       | 8,400                    |       |

- $\phi 3$ mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |       |       |       |       |       |
|-------------------|---------------------------|------------------|------------------------|-------------------------------------|-------|-------|-------|-------|-------|
|                   |                           |                  |                        | 30'                                 | 1°    | 1°30' | 2°    | 3°    |       |
| HLRS 4010-005-050 | 1                         | RO.05            | 5                      | 5.76                                | 6.04  | 6.28  | 6.50  | 6.98  |       |
| HLRS 4010-005-060 |                           |                  | 6                      | 6.81                                | 7.12  | 7.38  | 7.63  | 8.20  |       |
| HLRS 4010-005-080 |                           |                  | 8                      | 8.91                                | 9.27  | 9.58  | 9.91  | 10.65 |       |
| HLRS 4010-005-100 |                           |                  | 10                     | 11.00                               | 11.40 | 11.78 | 12.19 | 13.10 |       |
| HLRS 4010-005-120 |                           |                  | 12                     | 13.08                               | 13.53 | 13.98 | 14.47 | 15.55 |       |
| HLRS 4010-01-020  |                           | RO.1             | 2                      | 2.56                                | 2.74  | 2.89  | 3.04  | 3.30  |       |
| HLRS 4010-01-030  |                           |                  | 3                      | 3.63                                | 3.85  | 4.04  | 4.20  | 4.52  |       |
| HLRS 4010-01-040  |                           |                  | 4                      | 4.70                                | 4.95  | 5.16  | 5.35  | 5.75  |       |
| HLRS 4010-01-050  |                           |                  | 5                      | 5.75                                | 6.04  | 6.27  | 6.49  | 6.97  |       |
| HLRS 4010-01-060  |                           |                  | 6                      | 6.81                                | 7.12  | 7.37  | 7.63  | 8.19  |       |
| HLRS 4010-01-080  |                           | RO.1             | 8                      | 8.91                                | 9.26  | 9.57  | 9.90  | 10.64 |       |
| HLRS 4010-01-100  |                           |                  | 10                     | 11.00                               | 11.39 | 11.77 | 12.18 | 13.09 |       |
| HLRS 4010-01-120  |                           |                  | 12                     | 13.08                               | 13.52 | 13.98 | 14.46 | 15.54 |       |
| HLRS 4010-02-020  |                           |                  | RO.2                   | 2                                   | 2.55  | 2.72  | 2.88  | 3.02  | 3.28  |
| HLRS 4010-02-030  |                           |                  |                        | 3                                   | 3.62  | 3.84  | 4.02  | 4.19  | 4.50  |
| HLRS 4010-02-040  |                           | 4                |                        | 4.69                                | 4.94  | 5.15  | 5.34  | 5.72  |       |
| HLRS 4010-02-050  |                           | 5                |                        | 5.75                                | 6.03  | 6.26  | 6.47  | 6.95  |       |
| HLRS 4010-02-060  |                           | 6                |                        | 6.80                                | 7.11  | 7.36  | 7.61  | 8.17  |       |
| HLRS 4010-02-080  |                           | RO.2             | 8                      | 8.90                                | 9.26  | 9.56  | 9.89  | 10.62 |       |
| HLRS 4010-02-100  |                           |                  | 10                     | 10.99                               | 11.39 | 11.76 | 12.17 | 13.07 |       |
| HLRS 4010-02-120  |                           |                  | 12                     | 13.07                               | 13.52 | 13.97 | 14.45 | 15.51 |       |
| HLRS 4010-03-020  |                           |                  | RO.3                   | 2                                   | 2.54  | 2.71  | 2.86  | 3.00  | 3.25  |
| HLRS 4010-03-030  |                           |                  |                        | 3                                   | 3.62  | 3.83  | 4.01  | 4.17  | 4.48  |
| HLRS 4010-03-040  |                           | 4                |                        | 4.68                                | 4.93  | 5.14  | 5.32  | 5.70  |       |
| HLRS 4010-03-050  |                           | 5                |                        | 5.74                                | 6.02  | 6.25  | 6.46  | 6.93  |       |
| HLRS 4010-03-060  |                           | 6                |                        | 6.80                                | 7.10  | 7.35  | 7.60  | 8.15  |       |
| HLRS 4010-03-080  |                           | RO.3             | 8                      | 8.90                                | 9.25  | 9.55  | 9.88  | 10.60 |       |
| HLRS 4010-03-100  |                           |                  | 10                     | 10.99                               | 11.38 | 11.75 | 12.15 | 13.04 |       |
| HLRS 4010-03-120  |                           |                  | 12                     | 13.07                               | 13.51 | 13.96 | 14.43 | 15.49 |       |
| HLRS 4010-03-160  |                           |                  | 16                     | 17.22                               | 17.77 | 18.36 | 18.99 | 20.39 |       |
| HLRS 4012-01-040  |                           |                  | 1.2                    | RO.1                                | 4     | 4.13  | 4.27  | 4.41  | 4.56  |
| HLRS 4012-01-060  |                           | 6                |                        |                                     | 6.20  | 6.40  | 6.61  | 6.84  | 7.34  |
| HLRS 4012-01-100  |                           | 10               |                        |                                     | 10.32 | 10.66 | 11.01 | 11.39 | 12.24 |
| HLRS 4012-02-040  |                           | RO.2             |                        | 4                                   | 4.13  | 4.26  | 4.40  | 4.55  | 4.87  |
| HLRS 4012-02-060  |                           |                  |                        | 6                                   | 6.19  | 6.39  | 6.60  | 6.82  | 7.32  |
| HLRS 4012-02-100  |                           |                  |                        | 10                                  | 10.32 | 10.65 | 11.00 | 11.38 | 12.22 |
| HLRS 4012-03-040  | RO.3                      | 4                |                        | 4.13                                | 4.25  | 4.39  | 4.53  | 4.85  |       |
| HLRS 4012-03-060  |                           | 6                |                        | 6.19                                | 6.38  | 6.59  | 6.81  | 7.30  |       |
| HLRS 4012-03-100  |                           | 10               |                        | 10.32                               | 10.64 | 10.99 | 11.36 | 12.20 |       |

4 Flutes

 $\phi 3\text{mm}$  Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Square  
Long Neck  
SquareRadius  
Radius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
BallTaper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |       |
|-------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|-------|
| HLRS 4015-005-030 | 1.5                       | RO.05            | 3                         | 1.2                  | 1.45                     | 16°                       | 50               | 4                       | 7,900                    |       |
| HLRS 4015-005-040 |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 7,900                    |       |
| HLRS 4015-005-060 |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 7,900                    |       |
| HLRS 4015-005-080 |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,200                    |       |
| HLRS 4015-005-120 |                           |                  | 12                        |                      |                          |                           | 55               | 4                       | 8,200                    |       |
| HLRS 4015-005-160 |                           |                  | 16                        |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4015-01-030  |                           | RO.1             | 3                         |                      |                          |                           | 50               | 4                       | 7,900                    |       |
| HLRS 4015-01-040  |                           |                  | 4                         |                      |                          |                           | 50               | 4                       | 7,900                    |       |
| HLRS 4015-01-060  |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 7,900                    |       |
| HLRS 4015-01-080  |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,200                    |       |
| HLRS 4015-01-100  |                           |                  | 10                        |                      |                          |                           | 50               | 4                       | 8,200                    |       |
| HLRS 4015-01-120  |                           |                  | 12                        |                      |                          |                           | 55               | 4                       | 8,200                    |       |
| HLRS 4015-01-160  |                           |                  | 16                        |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4015-01-180  |                           |                  | 18                        |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4015-02-030  |                           |                  | RO.2                      |                      |                          |                           | 3                | 50                      | 4                        | 7,900 |
| HLRS 4015-02-040  |                           |                  |                           |                      |                          |                           | 4                | 50                      | 4                        | 7,900 |
| HLRS 4015-02-060  |                           |                  |                           |                      |                          |                           | 6                | 50                      | 4                        | 7,900 |
| HLRS 4015-02-080  |                           |                  |                           |                      |                          |                           | 8                | 50                      | 4                        | 8,200 |
| HLRS 4015-02-100  |                           |                  |                           |                      |                          |                           | 10               | 50                      | 4                        | 8,200 |
| HLRS 4015-02-120  |                           |                  |                           |                      |                          |                           | 12               | 55                      | 4                        | 8,200 |
| HLRS 4015-02-160  |                           |                  | 16                        |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4015-02-180  |                           |                  | 18                        |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4015-03-030  |                           |                  | RO.3                      |                      |                          |                           | 3                | 50                      | 4                        | 7,900 |
| HLRS 4015-03-040  |                           |                  |                           |                      |                          |                           | 4                | 50                      | 4                        | 7,900 |
| HLRS 4015-03-060  |                           | 6                |                           |                      |                          |                           | 50               | 4                       | 7,900                    |       |
| HLRS 4015-03-080  |                           | 8                |                           |                      |                          |                           | 50               | 4                       | 8,200                    |       |
| HLRS 4015-03-100  |                           | 10               |                           |                      |                          |                           | 50               | 4                       | 8,200                    |       |
| HLRS 4015-03-120  |                           | 12               |                           |                      |                          |                           | 55               | 4                       | 8,200                    |       |
| HLRS 4015-03-160  |                           | 16               | 60                        |                      |                          |                           | 4                | 8,200                   |                          |       |
| HLRS 4015-03-180  |                           | 18               | 60                        |                      |                          |                           | 4                | 8,200                   |                          |       |
| HLRS 4015-05-030  | RO.5                      | 3                | 50                        | 4                    | 7,900                    |                           |                  |                         |                          |       |
| HLRS 4015-05-040  |                           | 4                | 50                        | 4                    | 7,900                    |                           |                  |                         |                          |       |
| HLRS 4015-05-060  |                           | 6                | 50                        | 4                    | 7,900                    |                           |                  |                         |                          |       |
| HLRS 4015-05-080  |                           | 8                | 50                        | 4                    | 8,200                    |                           |                  |                         |                          |       |
| HLRS 4015-05-100  |                           | 10               | 50                        | 4                    | 8,200                    |                           |                  |                         |                          |       |
| HLRS 4015-05-120  |                           | 12               | 55                        | 4                    | 8,200                    |                           |                  |                         |                          |       |
| HLRS 4015-05-160  | 16                        | 60               | 4                         | 8,200                |                          |                           |                  |                         |                          |       |
| HLRS 4015-05-180  | 18                        | 60               | 4                         | 8,200                |                          |                           |                  |                         |                          |       |

3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |       |       |       |       |
|-------------------|---------------------------|------------------|------------------------|-------------------------------------|-------|-------|-------|-------|
|                   |                           |                  |                        | 30'                                 | 1°    | 1°30' | 2°    | 3°    |
| HLRS 4015-005-030 | 1.5                       | RO.05            | 3                      | 3.10                                | 3.20  | 3.31  | 3.43  | 3.68  |
| HLRS 4015-005-040 |                           |                  | 4                      | 4.14                                | 4.27  | 4.41  | 4.57  | 4.91  |
| HLRS 4015-005-060 |                           |                  | 6                      | 6.20                                | 6.40  | 6.61  | 6.84  | 7.35  |
| HLRS 4015-005-080 |                           |                  | 8                      | 8.26                                | 8.53  | 8.82  | 9.12  | 9.80  |
| HLRS 4015-005-120 |                           |                  | 12                     | 12.39                               | 12.79 | 13.22 | 13.68 | 14.70 |
| HLRS 4015-005-160 |                           |                  | 16                     | 16.51                               | 17.05 | 17.62 | 18.23 | 19.59 |
| HLRS 4015-01-030  |                           | RO.1             | 3                      | 3.10                                | 3.20  | 3.31  | 3.42  | 3.67  |
| HLRS 4015-01-040  |                           |                  | 4                      | 4.13                                | 4.27  | 4.41  | 4.56  | 4.90  |
| HLRS 4015-01-060  |                           |                  | 6                      | 6.20                                | 6.40  | 6.61  | 6.84  | 7.34  |
| HLRS 4015-01-080  |                           |                  | 8                      | 8.26                                | 8.53  | 8.81  | 9.11  | 9.79  |
| HLRS 4015-01-100  |                           |                  | 10                     | 10.32                               | 10.66 | 11.01 | 11.39 | 12.24 |
| HLRS 4015-01-120  |                           |                  | 12                     | 12.39                               | 12.79 | 13.21 | 13.67 | 14.69 |
| HLRS 4015-01-160  |                           | RO.2             | 16                     | 16.51                               | 17.04 | 17.61 | 18.22 | 19.58 |
| HLRS 4015-01-180  |                           |                  | 18                     | 18.57                               | 19.17 | 19.82 | 20.50 | 22.03 |
| HLRS 4015-02-030  |                           |                  | 3                      | 3.10                                | 3.20  | 3.30  | 3.41  | 3.65  |
| HLRS 4015-02-040  |                           |                  | 4                      | 4.13                                | 4.26  | 4.40  | 4.55  | 4.87  |
| HLRS 4015-02-060  |                           |                  | 6                      | 6.19                                | 6.39  | 6.60  | 6.82  | 7.32  |
| HLRS 4015-02-080  |                           |                  | 8                      | 8.26                                | 8.52  | 8.80  | 9.10  | 9.77  |
| HLRS 4015-02-100  |                           | RO.3             | 10                     | 10.32                               | 10.65 | 11.00 | 11.38 | 12.22 |
| HLRS 4015-02-120  |                           |                  | 12                     | 12.38                               | 12.78 | 13.20 | 13.66 | 14.66 |
| HLRS 4015-02-160  |                           |                  | 16                     | 16.51                               | 17.04 | 17.60 | 18.21 | 19.56 |
| HLRS 4015-02-180  |                           |                  | 18                     | 18.57                               | 19.17 | 19.81 | 20.49 | 22.01 |
| HLRS 4015-03-030  |                           |                  | 3                      | 3.10                                | 3.19  | 3.29  | 3.39  | 3.63  |
| HLRS 4015-03-040  |                           |                  | 4                      | 4.13                                | 4.25  | 4.39  | 4.53  | 4.85  |
| HLRS 4015-03-060  |                           | RO.5             | 6                      | 6.19                                | 6.38  | 6.59  | 6.81  | 7.30  |
| HLRS 4015-03-080  |                           |                  | 8                      | 8.25                                | 8.51  | 8.79  | 9.09  | 9.75  |
| HLRS 4015-03-100  |                           |                  | 10                     | 10.32                               | 10.64 | 10.99 | 11.36 | 12.20 |
| HLRS 4015-03-120  |                           |                  | 12                     | 12.38                               | 12.77 | 13.19 | 13.64 | 14.64 |
| HLRS 4015-03-160  |                           |                  | 16                     | 16.50                               | 17.03 | 17.59 | 18.20 | 19.54 |
| HLRS 4015-03-180  |                           |                  | 18                     | 18.57                               | 19.16 | 19.80 | 20.47 | 21.98 |
| HLRS 4015-05-030  |                           | RO.5             | 3                      | 3.09                                | 3.17  | 3.27  | 3.36  | 3.58  |
| HLRS 4015-05-040  |                           |                  | 4                      | 4.12                                | 4.24  | 4.37  | 4.50  | 4.81  |
| HLRS 4015-05-060  |                           |                  | 6                      | 6.18                                | 6.37  | 6.57  | 6.78  | 7.25  |
| HLRS 4015-05-080  |                           |                  | 8                      | 8.25                                | 8.50  | 8.77  | 9.06  | 9.70  |
| HLRS 4015-05-100  |                           |                  | 10                     | 10.31                               | 10.63 | 10.97 | 11.34 | 12.15 |
| HLRS 4015-05-120  |                           |                  | 12                     | 12.37                               | 12.76 | 13.17 | 13.61 | 14.60 |
| HLRS 4015-05-160  |                           |                  | 16                     | 16.50                               | 17.02 | 17.57 | 18.17 | 19.49 |
| HLRS 4015-05-180  |                           |                  | 18                     | 18.56                               | 19.15 | 19.77 | 20.44 | 21.94 |

4 Flutes

 $\phi 3$ mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank Ball

Ball

Long Neck  
BallTaper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Next Page →

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Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |       |
|-------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|-------|
| HLRS 4018-02-080  | 1.8                       | RO.2             | 8                         | 1.44                 | 1.72                     | 16°                       | 50               | 4                       | 8,200                    |       |
| HLRS 4018-02-100  |                           |                  | 10                        |                      |                          |                           | 50               | 4                       | 8,200                    |       |
| HLRS 4018-02-120  |                           |                  | 12                        |                      |                          |                           | 55               | 4                       | 8,200                    |       |
| HLRS 4018-02-140  |                           |                  | 14                        |                      |                          |                           | 55               | 4                       | 8,200                    |       |
| HLRS 4018-02-160  |                           |                  | 16                        |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4020-002-040 | 2                         | RO.02            | 4                         | 1.6                  | 1.92                     | 16°                       | 50               | 4                       | 7,900                    |       |
| HLRS 4020-002-060 |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 7,900                    |       |
| HLRS 4020-002-080 |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,200                    |       |
| HLRS 4020-002-100 |                           |                  | 10                        |                      |                          |                           | 50               | 4                       | 8,200                    |       |
| HLRS 4020-002-120 |                           |                  | 12                        |                      |                          |                           | 55               | 4                       | 8,200                    |       |
| HLRS 4020-002-160 |                           |                  | 16                        |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4020-002-200 |                           |                  | 20                        |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4020-005-040 |                           |                  | RO.05                     |                      |                          |                           | 4                | 50                      | 4                        | 7,900 |
| HLRS 4020-005-060 |                           |                  |                           |                      |                          |                           | 6                | 50                      | 4                        | 7,900 |
| HLRS 4020-005-080 |                           |                  |                           |                      |                          |                           | 8                | 50                      | 4                        | 8,200 |
| HLRS 4020-005-100 |                           | 10               |                           |                      |                          |                           | 50               | 4                       | 8,200                    |       |
| HLRS 4020-005-120 |                           | 12               |                           |                      |                          |                           | 55               | 4                       | 8,200                    |       |
| HLRS 4020-005-160 |                           | 16               |                           |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4020-005-200 |                           | 20               |                           |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4020-01-040  |                           | RO.1             |                           |                      |                          |                           | 4                | 50                      | 4                        | 7,900 |
| HLRS 4020-01-060  |                           |                  |                           |                      |                          |                           | 6                | 50                      | 4                        | 7,900 |
| HLRS 4020-01-080  |                           |                  |                           |                      |                          |                           | 8                | 50                      | 4                        | 8,200 |
| HLRS 4020-01-100  |                           |                  | 10                        |                      |                          |                           | 50               | 4                       | 8,200                    |       |
| HLRS 4020-01-120  |                           |                  | 12                        |                      |                          |                           | 55               | 4                       | 8,200                    |       |
| HLRS 4020-01-160  |                           |                  | 16                        |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4020-01-200  |                           |                  | 20                        |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4020-01-240  |                           |                  | 24                        |                      |                          |                           | 70               | 4                       | 8,200                    |       |
| HLRS 4020-02-040  |                           |                  | RO.2                      |                      |                          |                           | 4                | 50                      | 4                        | 7,900 |
| HLRS 4020-02-060  |                           |                  |                           |                      |                          |                           | 6                | 50                      | 4                        | 7,900 |
| HLRS 4020-02-080  |                           | 8                |                           |                      |                          |                           | 50               | 4                       | 8,200                    |       |
| HLRS 4020-02-100  |                           | 10               |                           |                      |                          |                           | 50               | 4                       | 8,200                    |       |
| HLRS 4020-02-120  |                           | 12               |                           |                      |                          |                           | 55               | 4                       | 8,200                    |       |
| HLRS 4020-02-160  |                           | 16               |                           |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4020-02-200  |                           | 20               |                           |                      |                          |                           | 60               | 4                       | 8,200                    |       |
| HLRS 4020-02-240  |                           | 24               |                           |                      |                          |                           | 70               | 4                       | 8,200                    |       |
| HLRS 4020-03-040  | RO.3                      | 4                |                           | 50                   | 4                        | 7,900                     |                  |                         |                          |       |
| HLRS 4020-03-060  |                           | 6                |                           | 50                   | 4                        | 7,900                     |                  |                         |                          |       |
| HLRS 4020-03-080  |                           | 8                | 50                        | 4                    | 8,200                    |                           |                  |                         |                          |       |
| HLRS 4020-03-100  |                           | 10               | 50                        | 4                    | 8,200                    |                           |                  |                         |                          |       |
| HLRS 4020-03-120  |                           | 12               | 55                        | 4                    | 8,200                    |                           |                  |                         |                          |       |
| HLRS 4020-03-160  |                           | 16               | 60                        | 4                    | 8,200                    |                           |                  |                         |                          |       |
| HLRS 4020-03-200  |                           | 20               | 60                        | 4                    | 8,200                    |                           |                  |                         |                          |       |
| HLRS 4020-03-240  |                           | 24               | 70                        | 4                    | 8,200                    |                           |                  |                         |                          |       |

- $\phi 3$ mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |       |       |                 |                 |
|-------------------|---------------------------|------------------|------------------------|-------------------------------------|-------|-------|-----------------|-----------------|
|                   |                           |                  |                        | 30'                                 | 1°    | 1°30' | 2°              | 3°              |
| HLRS 4018-02-080  | 1.8                       | RO.2             | 8                      | 8.29                                | 8.56  | 8.84  | 9.14            | 9.81            |
| HLRS 4018-02-100  |                           |                  | 10                     | 10.36                               | 10.69 | 11.04 | 11.42           | 12.26           |
| HLRS 4018-02-120  |                           |                  | 12                     | 12.42                               | 12.82 | 13.24 | 13.69           | 14.71           |
| HLRS 4018-02-140  |                           |                  | 14                     | 14.48                               | 14.95 | 15.44 | 15.97           | 17.15           |
| HLRS 4018-02-160  |                           |                  | 16                     | 16.54                               | 17.08 | 17.64 | 18.25           | 19.60           |
| HLRS 4020-002-040 | 2                         | RO.02            | 4                      | 4.17                                | 4.31  | 4.45  | 4.61            | 4.96            |
| HLRS 4020-002-060 |                           |                  | 6                      | 6.24                                | 6.44  | 6.66  | 6.89            | 7.40            |
| HLRS 4020-002-080 |                           |                  | 8                      | 8.30                                | 8.57  | 8.86  | 9.16            | 9.85            |
| HLRS 4020-002-100 |                           |                  | 10                     | 10.36                               | 10.70 | 11.06 | 11.44           | 12.30           |
| HLRS 4020-002-120 |                           |                  | 12                     | 12.42                               | 12.83 | 13.26 | 13.72           | 14.75           |
| HLRS 4020-002-160 |                           | 16               | 16.55                  | 17.09                               | 17.66 | 18.27 | No Interference |                 |
| HLRS 4020-002-200 |                           | 20               | 20.67                  | 21.35                               | 22.06 | 22.83 | No Interference |                 |
| HLRS 4020-005-040 |                           | RO.05            | 4                      | 4.17                                | 4.31  | 4.45  | 4.61            | 4.95            |
| HLRS 4020-005-060 |                           |                  | 6                      | 6.23                                | 6.44  | 6.65  | 6.88            | 7.40            |
| HLRS 4020-005-080 |                           |                  | 8                      | 8.30                                | 8.57  | 8.85  | 9.16            | 9.84            |
| HLRS 4020-005-100 |                           |                  | 10                     | 10.36                               | 10.70 | 11.05 | 11.44           | 12.29           |
| HLRS 4020-005-120 |                           |                  | 12                     | 12.42                               | 12.83 | 13.26 | 13.72           | 14.74           |
| HLRS 4020-005-160 |                           | 16               | 16.55                  | 17.08                               | 17.66 | 18.27 | No Interference |                 |
| HLRS 4020-005-200 |                           | 20               | 20.67                  | 21.34                               | 22.06 | 22.82 | No Interference |                 |
| HLRS 4020-01-040  |                           | RO.1             | 4                      | 4.17                                | 4.30  | 4.45  | 4.60            | 4.94            |
| HLRS 4020-01-060  |                           |                  | 6                      | 6.23                                | 6.43  | 6.65  | 6.88            | 7.39            |
| HLRS 4020-01-080  |                           |                  | 8                      | 8.30                                | 8.56  | 8.85  | 9.15            | 9.83            |
| HLRS 4020-01-100  |                           |                  | 10                     | 10.36                               | 10.69 | 11.05 | 11.43           | 12.28           |
| HLRS 4020-01-120  |                           |                  | 12                     | 12.42                               | 12.82 | 13.25 | 13.71           | 14.73           |
| HLRS 4020-01-160  |                           |                  | 16                     | 16.55                               | 17.08 | 17.65 | 18.26           | No Interference |
| HLRS 4020-01-200  | 20                        |                  | 20.67                  | 21.34                               | 22.05 | 22.82 | No Interference |                 |
| HLRS 4020-01-240  | 24                        |                  | 24.80                  | 25.60                               | 26.46 | 27.37 | No Interference |                 |
| HLRS 4020-02-040  | RO.2                      |                  | 4                      | 4.17                                | 4.30  | 4.44  | 4.59            | 4.92            |
| HLRS 4020-02-060  |                           |                  | 6                      | 6.23                                | 6.43  | 6.64  | 6.86            | 7.36            |
| HLRS 4020-02-080  |                           | 8                | 8.29                   | 8.56                                | 8.84  | 9.14  | 9.81            |                 |
| HLRS 4020-02-100  |                           | 10               | 10.36                  | 10.69                               | 11.04 | 11.42 | 12.26           |                 |
| HLRS 4020-02-120  |                           | 12               | 12.42                  | 12.82                               | 13.24 | 13.69 | 14.71           |                 |
| HLRS 4020-02-160  |                           | 16               | 16.54                  | 17.08                               | 17.64 | 18.25 | 19.60           |                 |
| HLRS 4020-02-200  |                           | 20               | 20.67                  | 21.33                               | 22.04 | 22.80 | No Interference |                 |
| HLRS 4020-02-240  |                           | 24               | 24.79                  | 25.59                               | 26.45 | 27.36 | No Interference |                 |
| HLRS 4020-03-040  | RO.3                      | 4                | 4.16                   | 4.29                                | 4.43  | 4.57  | 4.90            |                 |
| HLRS 4020-03-060  |                           | 6                | 6.23                   | 6.42                                | 6.63  | 6.85  | 7.34            |                 |
| HLRS 4020-03-080  |                           | 8                | 8.29                   | 8.55                                | 8.83  | 9.13  | 9.79            |                 |
| HLRS 4020-03-100  |                           | 10               | 10.35                  | 10.68                               | 11.03 | 11.40 | 12.24           |                 |
| HLRS 4020-03-120  |                           | 12               | 12.41                  | 12.81                               | 13.23 | 13.68 | 14.68           |                 |
| HLRS 4020-03-160  |                           | 16               | 16.54                  | 17.07                               | 17.63 | 18.24 | 19.58           |                 |
| HLRS 4020-03-200  |                           | 20               | 20.67                  | 21.33                               | 22.03 | 22.79 | No Interference |                 |
| HLRS 4020-03-240  |                           | 24               | 24.79                  | 25.59                               | 26.44 | 27.35 | No Interference |                 |

4 Flutes

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Square  
Long Neck  
Square

Radius  
Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Unit (mm)

| Model Number     | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|
| HLRS 4020-05-040 | 2                         | RO.5             | 4                         | 1.6                  | 1.92                     | 16°                       | 50               | 4                       | 7,900                    |
| HLRS 4020-05-060 |                           |                  | 6                         |                      |                          |                           | 50               | 4                       | 7,900                    |
| HLRS 4020-05-080 |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,200                    |
| HLRS 4020-05-100 |                           |                  | 10                        |                      |                          |                           | 50               | 4                       | 8,200                    |
| HLRS 4020-05-120 |                           |                  | 12                        |                      |                          |                           | 55               | 4                       | 8,200                    |
| HLRS 4020-05-160 |                           |                  | 16                        |                      |                          |                           | 60               | 4                       | 8,200                    |
| HLRS 4020-05-200 |                           |                  | 20                        |                      |                          |                           | 60               | 4                       | 8,200                    |
| HLRS 4020-05-240 |                           |                  | 24                        |                      |                          |                           | 70               | 4                       | 8,200                    |
| HLRS 4020-05-260 |                           |                  | 26                        |                      |                          |                           | 70               | 4                       | 8,200                    |
| HLRS 4020-05-300 |                           |                  | 30                        |                      |                          |                           | 70               | 4                       | 8,200                    |
| HLRS 4025-01-060 | 2.5                       | RO.1             | 6                         | 2                    | 2.42                     | 16°                       | 50               | 4                       | 8,600                    |
| HLRS 4025-01-080 |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,600                    |
| HLRS 4025-01-100 |                           |                  | 10                        |                      |                          |                           | 50               | 4                       | 8,600                    |
| HLRS 4025-01-160 |                           |                  | 16                        |                      |                          |                           | 60               | 4                       | 8,900                    |
| HLRS 4025-01-200 |                           |                  | 20                        |                      |                          |                           | 60               | 4                       | 8,900                    |
| HLRS 4025-01-300 |                           |                  | 30                        |                      |                          |                           | 70               | 4                       | 9,200                    |
| HLRS 4025-02-060 |                           | RO.2             | 6                         |                      |                          |                           | 50               | 4                       | 8,600                    |
| HLRS 4025-02-080 |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,600                    |
| HLRS 4025-02-100 |                           |                  | 10                        |                      |                          |                           | 50               | 4                       | 8,600                    |
| HLRS 4025-02-160 |                           |                  | 16                        |                      |                          |                           | 60               | 4                       | 8,900                    |
| HLRS 4025-02-200 |                           |                  | 20                        |                      |                          |                           | 60               | 4                       | 8,900                    |
| HLRS 4025-02-300 |                           |                  | 30                        |                      |                          |                           | 70               | 4                       | 9,200                    |
| HLRS 4025-03-060 |                           | RO.3             | 6                         |                      |                          |                           | 50               | 4                       | 8,600                    |
| HLRS 4025-03-080 |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,600                    |
| HLRS 4025-03-100 |                           |                  | 10                        |                      |                          |                           | 50               | 4                       | 8,600                    |
| HLRS 4025-03-160 |                           |                  | 16                        |                      |                          |                           | 60               | 4                       | 8,900                    |
| HLRS 4025-03-200 |                           |                  | 20                        |                      |                          |                           | 60               | 4                       | 8,900                    |
| HLRS 4025-03-300 |                           |                  | 30                        |                      |                          |                           | 70               | 4                       | 9,200                    |
| HLRS 4025-05-060 |                           | RO.5             | 6                         |                      |                          |                           | 50               | 4                       | 8,600                    |
| HLRS 4025-05-080 |                           |                  | 8                         |                      |                          |                           | 50               | 4                       | 8,600                    |
| HLRS 4025-05-100 |                           |                  | 10                        |                      |                          |                           | 50               | 4                       | 8,600                    |
| HLRS 4025-05-160 |                           |                  | 16                        |                      |                          |                           | 60               | 4                       | 8,900                    |
| HLRS 4025-05-200 |                           |                  | 20                        |                      |                          |                           | 60               | 4                       | 8,900                    |
| HLRS 4025-05-300 |                           |                  | 30                        |                      |                          |                           | 70               | 4                       | 9,200                    |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| Model Number     | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |       |                 |                 |                 |
|------------------|---------------------------|------------------|------------------------|-------------------------------------|-------|-----------------|-----------------|-----------------|
|                  |                           |                  |                        | 30'                                 | 1°    | 1°30'           | 2°              | 3°              |
| HLRS 4020-05-040 | 2                         | RO.5             | 4                      | 4.16                                | 4.28  | 4.40            | 4.54            | 4.85            |
| HLRS 4020-05-060 |                           |                  | 6                      | 6.22                                | 6.41  | 6.61            | 6.82            | 7.30            |
| HLRS 4020-05-080 |                           |                  | 8                      | 8.28                                | 8.54  | 8.81            | 9.10            | 9.74            |
| HLRS 4020-05-100 |                           |                  | 10                     | 10.34                               | 10.67 | 11.01           | 11.37           | 12.19           |
| HLRS 4020-05-120 |                           |                  | 12                     | 12.41                               | 12.79 | 13.21           | 13.65           | 14.64           |
| HLRS 4020-05-160 |                           |                  | 16                     | 16.53                               | 17.05 | 17.61           | 18.21           | 19.53           |
| HLRS 4020-05-200 |                           |                  | 20                     | 20.66                               | 21.31 | 22.01           | 22.76           | No Interference |
| HLRS 4020-05-240 |                           |                  | 24                     | 24.78                               | 25.57 | 26.41           | 27.32           | No Interference |
| HLRS 4020-05-260 |                           |                  | 26                     | 26.85                               | 27.70 | 28.62           | 29.59           | No Interference |
| HLRS 4020-05-300 |                           |                  | 30                     | 30.97                               | 31.96 | 33.02           | No Interference | No Interference |
| HLRS 4025-01-060 |                           |                  | 2.5                    | RO.1                                | 6     | 6.23            | 6.43            | 6.65            |
| HLRS 4025-01-080 | 8                         | 8.30             |                        |                                     | 8.56  | 8.85            | 9.15            | 9.83            |
| HLRS 4025-01-100 | 10                        | 10.36            |                        |                                     | 10.69 | 11.05           | 11.43           | 12.28           |
| HLRS 4025-01-160 | 16                        | 16.55            |                        |                                     | 17.08 | 17.65           | 18.26           | No Interference |
| HLRS 4025-01-200 | 20                        | 20.67            |                        |                                     | 21.34 | 22.05           | No Interference | No Interference |
| HLRS 4025-01-300 | 30                        | 30.99            |                        |                                     | 31.99 | No Interference | No Interference | No Interference |
| HLRS 4025-02-060 | RO.2                      | 6                |                        | 6.23                                | 6.43  | 6.64            | 6.86            | 7.36            |
| HLRS 4025-02-080 |                           | 8                |                        | 8.29                                | 8.56  | 8.84            | 9.14            | 9.81            |
| HLRS 4025-02-100 |                           | 10               |                        | 10.36                               | 10.69 | 11.04           | 11.42           | 12.26           |
| HLRS 4025-02-160 |                           | 16               |                        | 16.54                               | 17.08 | 17.64           | 18.25           | No Interference |
| HLRS 4025-02-200 |                           | 20               |                        | 20.67                               | 21.33 | 22.04           | No Interference | No Interference |
| HLRS 4025-02-300 |                           | 30               |                        | 30.98                               | 31.98 | No Interference | No Interference | No Interference |
| HLRS 4025-03-060 | RO.3                      | 6                |                        | 6.23                                | 6.42  | 6.63            | 6.85            | 7.34            |
| HLRS 4025-03-080 |                           | 8                |                        | 8.29                                | 8.55  | 8.83            | 9.13            | 9.79            |
| HLRS 4025-03-100 |                           | 10               |                        | 10.35                               | 10.68 | 11.03           | 11.40           | 12.24           |
| HLRS 4025-03-160 |                           | 16               |                        | 16.54                               | 17.07 | 17.63           | 18.24           | No Interference |
| HLRS 4025-03-200 |                           | 20               |                        | 20.67                               | 21.33 | 22.03           | No Interference | No Interference |
| HLRS 4025-03-300 |                           | 30               |                        | 30.98                               | 31.98 | No Interference | No Interference | No Interference |
| HLRS 4025-05-060 | RO.5                      | 6                |                        | 6.22                                | 6.41  | 6.61            | 6.82            | 7.30            |
| HLRS 4025-05-080 |                           | 8                |                        | 8.28                                | 8.54  | 8.81            | 9.10            | 9.74            |
| HLRS 4025-05-100 |                           | 10               |                        | 10.34                               | 10.67 | 11.01           | 11.37           | 12.19           |
| HLRS 4025-05-160 |                           | 16               |                        | 16.53                               | 17.05 | 17.61           | 18.21           | No Interference |
| HLRS 4025-05-200 |                           | 20               |                        | 20.66                               | 21.31 | 22.01           | No Interference | No Interference |
| HLRS 4025-05-300 |                           | 30               |                        | 30.97                               | 31.96 | No Interference | No Interference | No Interference |

4 Flutes

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |        |
|-------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|--------|
| HLRS 4030-005-040 | 3                         | RO.05            | 4                         | 2.4                  | 2.92                     | 16°                   | 55               | 6                       | 7,100                    |        |
| HLRS 4030-005-060 |                           |                  | 6                         |                      |                          |                       | 55               | 6                       | 7,100                    |        |
| HLRS 4030-005-080 |                           |                  | 8                         |                      |                          |                       | 55               | 6                       | 7,100                    |        |
| HLRS 4030-005-100 |                           |                  | 10                        |                      |                          |                       | 55               | 6                       | 7,100                    |        |
| HLRS 4030-005-120 |                           |                  | 12                        |                      |                          |                       | 55               | 6                       | 8,600                    |        |
| HLRS 4030-005-160 |                           |                  | 16                        |                      |                          |                       | 60               | 6                       | 10,600                   |        |
| HLRS 4030-005-200 |                           |                  | 20                        |                      |                          |                       | 60               | 6                       | 10,600                   |        |
| HLRS 4030-01-040  |                           |                  | RO.1                      |                      |                          |                       | 4                | 55                      | 6                        | 7,100  |
| HLRS 4030-01-060  |                           | 6                |                           |                      |                          |                       | 55               | 6                       | 7,100                    |        |
| HLRS 4030-01-080  |                           | 8                |                           |                      |                          |                       | 55               | 6                       | 7,100                    |        |
| HLRS 4030-01-100  |                           | 10               |                           |                      |                          |                       | 55               | 6                       | 7,100                    |        |
| HLRS 4030-01-120  |                           | 12               |                           |                      |                          |                       | 55               | 6                       | 8,600                    |        |
| HLRS 4030-01-160  |                           | 16               |                           |                      |                          |                       | 60               | 6                       | 10,600                   |        |
| HLRS 4030-01-180  |                           | 18               |                           |                      |                          |                       | 60               | 6                       | 10,600                   |        |
| HLRS 4030-01-200  |                           | 20               |                           |                      |                          |                       | 60               | 6                       | 10,600                   |        |
| HLRS 4030-01-240  |                           | 24               |                           |                      |                          |                       | 70               | 6                       | 10,600                   |        |
| HLRS 4030-01-260  |                           | 26               |                           |                      |                          |                       | 70               | 6                       | 10,600                   |        |
| HLRS 4030-01-300  |                           | 30               |                           |                      |                          |                       | 70               | 6                       | 12,000                   |        |
| HLRS 4030-02-040  |                           | RO.2             |                           |                      |                          |                       | 4                | 55                      | 6                        | 7,100  |
| HLRS 4030-02-060  |                           |                  |                           |                      |                          |                       | 6                | 55                      | 6                        | 7,100  |
| HLRS 4030-02-080  |                           |                  |                           |                      |                          |                       | 8                | 55                      | 6                        | 7,100  |
| HLRS 4030-02-100  |                           |                  |                           |                      |                          |                       | 10               | 55                      | 6                        | 7,100  |
| HLRS 4030-02-120  |                           |                  |                           |                      |                          |                       | 12               | 55                      | 6                        | 8,600  |
| HLRS 4030-02-160  |                           |                  |                           |                      |                          |                       | 16               | 60                      | 6                        | 10,600 |
| HLRS 4030-02-180  |                           |                  |                           |                      |                          |                       | 18               | 60                      | 6                        | 10,600 |
| HLRS 4030-02-200  |                           |                  | 20                        |                      |                          |                       | 60               | 6                       | 10,600                   |        |
| HLRS 4030-02-240  |                           |                  | 24                        |                      |                          |                       | 70               | 6                       | 10,600                   |        |
| HLRS 4030-02-260  |                           |                  | 26                        |                      |                          |                       | 70               | 6                       | 10,600                   |        |
| HLRS 4030-02-300  |                           |                  | 30                        |                      |                          |                       | 70               | 6                       | 12,000                   |        |
| HLRS 4030-02-360  |                           |                  | 36                        |                      |                          |                       | 80               | 6                       | 12,000                   |        |
| HLRS 4030-03-040  |                           | RO.3             | 4                         |                      |                          |                       | 55               | 6                       | 7,100                    |        |
| HLRS 4030-03-060  |                           |                  | 6                         |                      |                          |                       | 55               | 6                       | 7,100                    |        |
| HLRS 4030-03-080  |                           |                  | 8                         |                      |                          |                       | 55               | 6                       | 7,100                    |        |
| HLRS 4030-03-100  |                           |                  | 10                        |                      |                          |                       | 55               | 6                       | 7,100                    |        |
| HLRS 4030-03-120  |                           |                  | 12                        |                      |                          |                       | 55               | 6                       | 8,600                    |        |
| HLRS 4030-03-140  |                           |                  | 14                        |                      |                          |                       | 55               | 6                       | 8,600                    |        |
| HLRS 4030-03-160  | 16                        |                  | 60                        | 6                    | 10,600                   |                       |                  |                         |                          |        |
| HLRS 4030-03-200  | 20                        |                  | 60                        | 6                    | 10,600                   |                       |                  |                         |                          |        |
| HLRS 4030-03-240  | 24                        |                  | 70                        | 6                    | 10,600                   |                       |                  |                         |                          |        |
| HLRS 4030-03-260  | 26                        |                  | 70                        | 6                    | 10,600                   |                       |                  |                         |                          |        |
| HLRS 4030-03-300  | 30                        |                  | 70                        | 6                    | 12,000                   |                       |                  |                         |                          |        |
| HLRS 4030-03-360  | 36                        |                  | 80                        | 6                    | 12,000                   |                       |                  |                         |                          |        |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |       |                 |                 |                 |
|-------------------|---------------------------|------------------|------------------------|-------------------------------------|-------|-----------------|-----------------|-----------------|
|                   |                           |                  |                        | 30'                                 | 1°    | 1°30'           | 2°              | 3°              |
| HLRS 4030-005-040 | 3                         | RO.05            | 4                      | 4.17                                | 4.31  | 4.45            | 4.60            | 4.95            |
| HLRS 4030-005-060 |                           |                  | 6                      | 6.23                                | 6.43  | 6.65            | 6.88            | 7.40            |
| HLRS 4030-005-080 |                           |                  | 8                      | 8.30                                | 8.56  | 8.85            | 9.16            | 9.84            |
| HLRS 4030-005-100 |                           |                  | 10                     | 10.36                               | 10.69 | 11.05           | 11.44           | 12.29           |
| HLRS 4030-005-120 |                           |                  | 12                     | 12.42                               | 12.82 | 13.25           | 13.71           | 14.74           |
| HLRS 4030-005-160 |                           |                  | 16                     | 16.55                               | 17.08 | 17.66           | 18.27           | 19.63           |
| HLRS 4030-005-200 |                           |                  | 20                     | 20.67                               | 21.34 | 22.06           | 22.82           | 24.53           |
| HLRS 4030-01-040  |                           | RO.1             | 4                      | 4.17                                | 4.30  | 4.44            | 4.60            | 4.94            |
| HLRS 4030-01-060  |                           |                  | 6                      | 6.23                                | 6.43  | 6.65            | 6.87            | 7.38            |
| HLRS 4030-01-080  |                           |                  | 8                      | 8.29                                | 8.56  | 8.85            | 9.15            | 9.83            |
| HLRS 4030-01-100  |                           |                  | 10                     | 10.36                               | 10.69 | 11.05           | 11.43           | 12.28           |
| HLRS 4030-01-120  |                           |                  | 12                     | 12.42                               | 12.82 | 13.25           | 13.71           | 14.73           |
| HLRS 4030-01-160  |                           |                  | 16                     | 16.54                               | 17.08 | 17.65           | 18.26           | 19.62           |
| HLRS 4030-01-180  |                           |                  | 18                     | 18.61                               | 19.21 | 19.85           | 20.54           | 22.07           |
| HLRS 4030-01-200  |                           |                  | 20                     | 20.67                               | 21.34 | 22.05           | 22.82           | 24.52           |
| HLRS 4030-01-240  |                           |                  | 24                     | 24.80                               | 25.60 | 26.45           | 27.37           | No Interference |
| HLRS 4030-01-260  |                           |                  | 26                     | 26.86                               | 27.73 | 28.66           | 29.65           | No Interference |
| HLRS 4030-01-300  |                           | 30               | 30.98                  | 31.99                               | 33.06 | 34.20           | No Interference |                 |
| HLRS 4030-02-040  |                           | RO.2             | 4                      | 4.17                                | 4.30  | 4.43            | 4.58            | 4.92            |
| HLRS 4030-02-060  |                           |                  | 6                      | 6.23                                | 6.43  | 6.64            | 6.86            | 7.36            |
| HLRS 4030-02-080  |                           |                  | 8                      | 8.29                                | 8.55  | 8.84            | 9.14            | 9.81            |
| HLRS 4030-02-100  |                           |                  | 10                     | 10.35                               | 10.68 | 11.04           | 11.42           | 12.26           |
| HLRS 4030-02-120  |                           |                  | 12                     | 12.42                               | 12.81 | 13.24           | 13.69           | 14.70           |
| HLRS 4030-02-160  |                           |                  | 16                     | 16.54                               | 17.07 | 17.64           | 18.25           | 19.60           |
| HLRS 4030-02-180  |                           |                  | 18                     | 18.60                               | 19.20 | 19.84           | 20.53           | 22.05           |
| HLRS 4030-02-200  |                           |                  | 20                     | 20.67                               | 21.33 | 22.04           | 22.80           | 24.49           |
| HLRS 4030-02-240  |                           |                  | 24                     | 24.79                               | 25.59 | 26.44           | 27.36           | No Interference |
| HLRS 4030-02-260  |                           |                  | 26                     | 26.86                               | 27.72 | 28.65           | 29.63           | No Interference |
| HLRS 4030-02-300  |                           | 30               | 30.98                  | 31.98                               | 33.05 | 34.19           | No Interference |                 |
| HLRS 4030-02-360  |                           | 36               | 37.17                  | 38.37                               | 39.65 | 41.02           | No Interference |                 |
| HLRS 4030-03-040  |                           | RO.3             | 4                      | 4.16                                | 4.29  | 4.42            | 4.57            | 4.89            |
| HLRS 4030-03-060  |                           |                  | 6                      | 6.22                                | 6.42  | 6.63            | 6.85            | 7.34            |
| HLRS 4030-03-080  |                           |                  | 8                      | 8.29                                | 8.55  | 8.83            | 9.12            | 9.79            |
| HLRS 4030-03-100  |                           |                  | 10                     | 10.35                               | 10.68 | 11.03           | 11.40           | 12.24           |
| HLRS 4030-03-120  |                           |                  | 12                     | 12.41                               | 12.81 | 13.23           | 13.68           | 14.68           |
| HLRS 4030-03-140  |                           |                  | 14                     | 14.48                               | 14.94 | 15.43           | 15.96           | 17.13           |
| HLRS 4030-03-160  | 16                        |                  | 16.54                  | 17.07                               | 17.63 | 18.23           | 19.58           |                 |
| HLRS 4030-03-200  | 20                        |                  | 20.66                  | 21.33                               | 22.03 | 22.79           | 24.47           |                 |
| HLRS 4030-03-240  | 24                        |                  | 24.79                  | 25.59                               | 26.43 | 27.34           | No Interference |                 |
| HLRS 4030-03-260  | 26                        |                  | 26.85                  | 27.71                               | 28.64 | 29.62           | No Interference |                 |
| HLRS 4030-03-300  | 30                        | 30.98            | 31.97                  | 33.04                               | 34.18 | No Interference |                 |                 |
| HLRS 4030-03-360  | 36                        | 37.17            | 38.36                  | 39.64                               | 41.01 | No Interference |                 |                 |

4 Flutes

 $\phi 3$ mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|
| HLRS 4030-05-040  | 3                         | RO.5             | 4                         | 2.4                  | 2.92                     | 16°                       | 55               | 6                       | 7,100                    |
| HLRS 4030-05-060  |                           |                  | 6                         |                      |                          |                           | 55               | 6                       | 7,100                    |
| HLRS 4030-05-080  |                           |                  | 8                         |                      |                          |                           | 55               | 6                       | 7,100                    |
| HLRS 4030-05-100  |                           |                  | 10                        |                      |                          |                           | 55               | 6                       | 7,100                    |
| HLRS 4030-05-120  |                           |                  | 12                        |                      |                          |                           | 55               | 6                       | 8,600                    |
| HLRS 4030-05-160  |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HLRS 4030-05-200  |                           |                  | 20                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HLRS 4030-05-240  |                           |                  | 24                        |                      |                          |                           | 70               | 6                       | 10,600                   |
| HLRS 4030-05-260  |                           |                  | 26                        |                      |                          |                           | 70               | 6                       | 10,600                   |
| HLRS 4030-05-300  |                           |                  | 30                        |                      |                          |                           | 70               | 6                       | 12,000                   |
| HLRS 4030-05-360  |                           | 36               | 80                        |                      |                          |                           | 6                | 12,000                  |                          |
| HLRS 4030-10-060  |                           | R1               | 6                         |                      |                          |                           | 55               | 6                       | 7,100                    |
| HLRS 4030-10-080  |                           |                  | 8                         |                      |                          |                           | 55               | 6                       | 7,100                    |
| HLRS 4030-10-100  |                           |                  | 10                        |                      |                          |                           | 55               | 6                       | 7,100                    |
| HLRS 4030-10-120  |                           |                  | 12                        |                      |                          |                           | 55               | 6                       | 8,600                    |
| HLRS 4030-10-160  |                           |                  | 16                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HLRS 4030-10-200  |                           |                  | 20                        |                      |                          |                           | 60               | 6                       | 10,600                   |
| HLRS 4030-10-240  |                           |                  | 24                        |                      |                          |                           | 70               | 6                       | 10,600                   |
| HLRS 4030-10-260  |                           |                  | 26                        |                      |                          |                           | 70               | 6                       | 10,600                   |
| HLRS 4030-10-300  |                           |                  | 30                        |                      |                          |                           | 70               | 6                       | 12,000                   |
| HLRS 4030-10-360  | 36                        |                  | 80                        | 6                    | 12,000                   |                           |                  |                         |                          |
| HLRS 4040-005-080 | 4                         | RO.05            | 8                         | 3.2                  | 3.82                     | 16°                       | 65               | 6                       | 10,600                   |
| HLRS 4040-005-120 |                           |                  | 12                        |                      |                          |                           | 65               | 6                       | 10,600                   |
| HLRS 4040-005-160 |                           |                  | 16                        |                      |                          |                           | 65               | 6                       | 10,600                   |
| HLRS 4040-005-200 |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 11,800                   |
| HLRS 4040-005-240 |                           |                  | 24                        |                      |                          |                           | 70               | 6                       | 11,800                   |
| HLRS 4040-005-320 |                           |                  | 32                        |                      |                          |                           | 80               | 6                       | 11,800                   |
| HLRS 4040-01-080  |                           | RO.1             | 8                         |                      |                          |                           | 65               | 6                       | 10,600                   |
| HLRS 4040-01-120  |                           |                  | 12                        |                      |                          |                           | 65               | 6                       | 10,600                   |
| HLRS 4040-01-160  |                           |                  | 16                        |                      |                          |                           | 65               | 6                       | 10,600                   |
| HLRS 4040-01-200  |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 11,800                   |
| HLRS 4040-01-240  |                           |                  | 24                        |                      |                          |                           | 70               | 6                       | 11,800                   |
| HLRS 4040-01-320  |                           |                  | 32                        |                      |                          |                           | 80               | 6                       | 11,800                   |
| HLRS 4040-01-480  |                           | 48               | 100                       |                      |                          |                           | 6                | 18,800                  |                          |
| HLRS 4040-02-080  |                           | RO.2             | 8                         |                      |                          |                           | 65               | 6                       | 10,600                   |
| HLRS 4040-02-120  |                           |                  | 12                        |                      |                          |                           | 65               | 6                       | 10,600                   |
| HLRS 4040-02-160  |                           |                  | 16                        |                      |                          |                           | 65               | 6                       | 10,600                   |
| HLRS 4040-02-200  |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 11,800                   |
| HLRS 4040-02-240  |                           |                  | 24                        |                      |                          |                           | 70               | 6                       | 11,800                   |
| HLRS 4040-02-320  |                           |                  | 32                        |                      |                          |                           | 80               | 6                       | 11,800                   |
| HLRS 4040-02-480  |                           |                  | 48                        |                      |                          |                           | 100              | 6                       | 18,800                   |

- $\phi 3$ mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |       |                 |                 |                 |
|-------------------|---------------------------|------------------|------------------------|-------------------------------------|-------|-----------------|-----------------|-----------------|
|                   |                           |                  |                        | 30'                                 | 1°    | 1°30'           | 2°              | 3°              |
| HLRS 4030-05-040  | 3                         | RO.5             | 4                      | 4.15                                | 4.27  | 4.40            | 4.54            | 4.85            |
| HLRS 4030-05-060  |                           |                  | 6                      | 6.22                                | 6.40  | 6.60            | 6.82            | 7.30            |
| HLRS 4030-05-080  |                           |                  | 8                      | 8.28                                | 8.53  | 8.80            | 9.10            | 9.74            |
| HLRS 4030-05-100  |                           |                  | 10                     | 10.34                               | 10.66 | 11.01           | 11.37           | 12.19           |
| HLRS 4030-05-120  |                           |                  | 12                     | 12.40                               | 12.79 | 13.21           | 13.65           | 14.64           |
| HLRS 4030-05-160  |                           |                  | 16                     | 16.53                               | 17.05 | 17.61           | 18.20           | 19.53           |
| HLRS 4030-05-200  |                           |                  | 20                     | 20.66                               | 21.31 | 22.01           | 22.76           | 24.43           |
| HLRS 4030-05-240  |                           |                  | 24                     | 24.78                               | 25.57 | 26.41           | 27.31           | 29.32           |
| HLRS 4030-05-260  |                           |                  | 26                     | 26.84                               | 27.70 | 28.61           | 29.59           | No Interference |
| HLRS 4030-05-300  |                           |                  | 30                     | 30.97                               | 31.96 | 33.02           | 34.15           | No Interference |
| HLRS 4030-05-360  |                           | 36               | 37.16                  | 38.35                               | 39.62 | 40.98           | No Interference |                 |
| HLRS 4030-10-060  |                           | R1               | 6                      | 6.20                                | 6.37  | 6.55            | 6.75            | 7.18            |
| HLRS 4030-10-080  |                           |                  | 8                      | 8.26                                | 8.50  | 8.75            | 9.03            | 9.63            |
| HLRS 4030-10-100  |                           |                  | 10                     | 10.32                               | 10.63 | 10.95           | 11.30           | 12.08           |
| HLRS 4030-10-120  |                           |                  | 12                     | 12.39                               | 12.76 | 13.16           | 13.58           | 14.53           |
| HLRS 4030-10-160  |                           |                  | 16                     | 16.51                               | 17.02 | 17.56           | 18.13           | 19.42           |
| HLRS 4030-10-200  |                           |                  | 20                     | 20.64                               | 21.28 | 21.96           | 22.69           | 24.32           |
| HLRS 4030-10-240  |                           |                  | 24                     | 24.76                               | 25.54 | 26.36           | 27.24           | 29.21           |
| HLRS 4030-10-260  |                           |                  | 26                     | 26.83                               | 27.67 | 28.56           | 29.52           | No Interference |
| HLRS 4030-10-300  |                           |                  | 30                     | 30.95                               | 31.93 | 32.96           | 34.08           | No Interference |
| HLRS 4030-10-360  | 36                        |                  | 37.14                  | 38.31                               | 39.57 | 40.91           | No Interference |                 |
| HLRS 4040-005-080 | 4                         | RO.05            | 8                      | 8.48                                | 8.75  | 9.04            | 9.36            | 10.06           |
| HLRS 4040-005-120 |                           |                  | 12                     | 12.60                               | 13.01 | 13.45           | 13.91           | 14.95           |
| HLRS 4040-005-160 |                           |                  | 16                     | 16.73                               | 17.27 | 17.85           | 18.47           | No Interference |
| HLRS 4040-005-200 |                           |                  | 20                     | 20.85                               | 21.53 | 22.25           | 23.02           | No Interference |
| HLRS 4040-005-240 |                           |                  | 24                     | 24.98                               | 25.79 | 26.65           | 27.58           | No Interference |
| HLRS 4040-005-320 |                           |                  | 32                     | 33.23                               | 34.31 | 35.46           | No Interference | No Interference |
| HLRS 4040-01-080  |                           | RO.1             | 8                      | 8.47                                | 8.75  | 9.04            | 9.35            | 10.05           |
| HLRS 4040-01-120  |                           |                  | 12                     | 12.60                               | 13.01 | 13.44           | 13.91           | 14.94           |
| HLRS 4040-01-160  |                           |                  | 16                     | 16.72                               | 17.27 | 17.84           | 18.46           | No Interference |
| HLRS 4040-01-200  |                           |                  | 20                     | 20.85                               | 21.52 | 22.24           | 23.01           | No Interference |
| HLRS 4040-01-240  |                           |                  | 24                     | 24.98                               | 25.78 | 26.65           | 27.57           | No Interference |
| HLRS 4040-01-320  |                           |                  | 32                     | 33.23                               | 34.30 | 35.45           | No Interference | No Interference |
| HLRS 4040-01-480  |                           |                  | 48                     | 49.73                               | 51.34 | No Interference | No Interference | No Interference |
| HLRS 4040-02-080  |                           |                  | RO.2                   | 8                                   | 8.47  | 8.74            | 9.03            | 9.34            |
| HLRS 4040-02-120  |                           | 12               |                        | 12.60                               | 13.00 | 13.43           | 13.89           | 14.92           |
| HLRS 4040-02-160  |                           | 16               |                        | 16.72                               | 17.26 | 17.83           | 18.45           | No Interference |
| HLRS 4040-02-200  |                           | 20               |                        | 20.85                               | 21.52 | 22.23           | 23.00           | No Interference |
| HLRS 4040-02-240  |                           | 24               |                        | 24.97                               | 25.78 | 26.64           | 27.56           | No Interference |
| HLRS 4040-02-320  |                           | 32               |                        | 33.22                               | 34.30 | 35.44           | No Interference | No Interference |
| HLRS 4040-02-480  |                           | 48               |                        | 49.73                               | 51.33 | No Interference | No Interference | No Interference |

4 Flutes

 $\phi 3\text{mm}$  Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
BallTaper Neck  
BallTaper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |        |     |    |        |
|-------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|--------|-----|----|--------|
| HLRS 4040-03-080  | 4                         | RO.3             | 8                         | 3.2                  | 3.82                     | 16°                       | 65               | 6                       | 10,600                   |        |     |    |        |
| HLRS 4040-03-120  |                           |                  | 12                        |                      |                          |                           | 65               | 6                       | 10,600                   |        |     |    |        |
| HLRS 4040-03-140  |                           |                  | 14                        |                      |                          |                           | 65               | 6                       | 10,600                   |        |     |    |        |
| HLRS 4040-03-160  |                           |                  | 16                        |                      |                          |                           | 65               | 6                       | 10,600                   |        |     |    |        |
| HLRS 4040-03-200  |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 11,800                   |        |     |    |        |
| HLRS 4040-03-240  |                           |                  | 24                        |                      |                          |                           | 70               | 6                       | 11,800                   |        |     |    |        |
| HLRS 4040-03-320  |                           |                  | 32                        |                      |                          |                           | 80               | 6                       | 11,800                   |        |     |    |        |
| HLRS 4040-03-480  |                           |                  | 48                        |                      |                          |                           | 100              | 6                       | 18,800                   |        |     |    |        |
| HLRS 4040-05-080  |                           | RO.5             | 8                         |                      |                          |                           | 65               | 6                       | 10,600                   |        |     |    |        |
| HLRS 4040-05-120  |                           |                  | 12                        |                      |                          |                           | 65               | 6                       | 10,600                   |        |     |    |        |
| HLRS 4040-05-160  |                           |                  | 16                        |                      |                          |                           | 65               | 6                       | 10,600                   |        |     |    |        |
| HLRS 4040-05-200  |                           |                  | 20                        |                      |                          |                           | 70               | 6                       | 11,800                   |        |     |    |        |
| HLRS 4040-05-240  |                           |                  | 24                        |                      |                          |                           | 70               | 6                       | 11,800                   |        |     |    |        |
| HLRS 4040-05-320  |                           |                  | 32                        |                      |                          |                           | 80               | 6                       | 11,800                   |        |     |    |        |
| HLRS 4040-05-400  |                           |                  | 40                        |                      |                          |                           | 100              | 6                       | 17,500                   |        |     |    |        |
| HLRS 4040-05-480  |                           |                  | 48                        |                      |                          |                           | 100              | 6                       | 18,800                   |        |     |    |        |
| HLRS 4040-10-080  |                           |                  | R1                        |                      |                          |                           | 8                | 65                      | 6                        | 10,600 |     |    |        |
| HLRS 4040-10-120  |                           |                  |                           |                      |                          |                           | 12               | 65                      | 6                        | 10,600 |     |    |        |
| HLRS 4040-10-160  |                           | 16               |                           |                      |                          |                           | 65               | 6                       | 10,600                   |        |     |    |        |
| HLRS 4040-10-200  |                           | 20               |                           |                      |                          |                           | 70               | 6                       | 11,800                   |        |     |    |        |
| HLRS 4040-10-240  |                           | 24               |                           |                      |                          |                           | 70               | 6                       | 11,800                   |        |     |    |        |
| HLRS 4040-10-320  |                           | 32               |                           |                      |                          |                           | 80               | 6                       | 11,800                   |        |     |    |        |
| HLRS 4040-10-480  |                           | 48               |                           |                      |                          |                           | 100              | 6                       | 18,800                   |        |     |    |        |
| HLRS 4050-005-160 |                           | 5                |                           |                      |                          |                           | RO.05            | 16                      | 4                        | 4.82   | 16° | 65 | 6      |
| HLRS 4050-005-200 |                           |                  | 20                        |                      |                          |                           |                  | 70                      |                          |        |     | 6  | 14,000 |
| HLRS 4050-005-400 |                           |                  | 40                        |                      |                          |                           |                  | 100                     |                          |        |     | 6  | 17,500 |
| HLRS 4050-01-160  |                           |                  | RO.1                      |                      |                          |                           | 16               | 65                      |                          |        |     | 6  | 14,300 |
| HLRS 4050-01-200  |                           |                  |                           |                      |                          |                           | 20               | 70                      |                          |        |     | 6  | 14,000 |
| HLRS 4050-01-400  | 40                        |                  |                           | 100                  | 6                        | 17,500                    |                  |                         |                          |        |     |    |        |
| HLRS 4050-02-160  | RO.2                      |                  | 16                        | 65                   | 6                        | 14,000                    |                  |                         |                          |        |     |    |        |
| HLRS 4050-02-200  |                           |                  | 20                        | 70                   | 6                        | 14,000                    |                  |                         |                          |        |     |    |        |
| HLRS 4050-02-400  |                           |                  | 40                        | 100                  | 6                        | 17,500                    |                  |                         |                          |        |     |    |        |
| HLRS 4050-03-160  | RO.3                      |                  | 16                        | 65                   | 6                        | 14,000                    |                  |                         |                          |        |     |    |        |
| HLRS 4050-03-200  |                           |                  | 20                        | 70                   | 6                        | 14,000                    |                  |                         |                          |        |     |    |        |
| HLRS 4050-03-400  |                           |                  | 40                        | 100                  | 6                        | 17,500                    |                  |                         |                          |        |     |    |        |
| HLRS 4050-05-160  | RO.5                      |                  | 16                        | 65                   | 6                        | 14,000                    |                  |                         |                          |        |     |    |        |
| HLRS 4050-05-200  |                           |                  | 20                        | 70                   | 6                        | 14,000                    |                  |                         |                          |        |     |    |        |
| HLRS 4050-05-400  |                           |                  | 40                        | 100                  | 6                        | 17,500                    |                  |                         |                          |        |     |    |        |
| HLRS 4050-10-160  | R1                        |                  | 16                        | 65                   | 6                        | 14,000                    |                  |                         |                          |        |     |    |        |
| HLRS 4050-10-200  |                           |                  | 20                        | 70                   | 6                        | 14,000                    |                  |                         |                          |        |     |    |        |
| HLRS 4050-10-400  |                           |                  | 40                        | 100                  | 6                        | 17,500                    |                  |                         |                          |        |     |    |        |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taber

Barrel

Spiral V Cutter

Drill

Technical Data

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |                 |                 |                 |                 |                 |
|-------------------|---------------------------|------------------|------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                   |                           |                  |                        | 30'                                 | 1°              | 1°30'           | 2°              | 3°              |                 |
| HLRS 4040-03-080  | 4                         | RO.3             | 8                      | 8.47                                | 8.73            | 9.02            | 9.32            | 10.00           |                 |
| HLRS 4040-03-120  |                           |                  | 12                     | 12.59                               | 12.99           | 13.42           | 13.88           | 14.90           |                 |
| HLRS 4040-03-140  |                           |                  | 14                     | 14.66                               | 15.12           | 15.62           | 16.16           | 17.34           |                 |
| HLRS 4040-03-160  |                           |                  | 16                     | 16.72                               | 17.25           | 17.82           | 18.43           | No Interference |                 |
| HLRS 4040-03-200  |                           |                  | 20                     | 20.84                               | 21.51           | 22.22           | 22.99           | No Interference |                 |
| HLRS 4040-03-240  |                           |                  | 24                     | 24.97                               | 25.77           | 26.63           | 27.54           | No Interference |                 |
| HLRS 4040-03-320  |                           |                  | 32                     | 33.22                               | 34.29           | 35.43           | No Interference | No Interference |                 |
| HLRS 4040-03-480  |                           |                  | 48                     | 49.72                               | 51.33           | No Interference | No Interference | No Interference |                 |
| HLRS 4040-05-080  |                           | RO.5             | 8                      | 8.46                                | 8.72            | 9.00            | 9.29            | 9.96            |                 |
| HLRS 4040-05-120  |                           |                  | 12                     | 12.58                               | 12.98           | 13.40           | 13.85           | 14.85           |                 |
| HLRS 4040-05-160  |                           |                  | 16                     | 16.71                               | 17.24           | 17.80           | 18.40           | 19.75           |                 |
| HLRS 4040-05-200  |                           |                  | 20                     | 20.84                               | 21.50           | 22.20           | 22.96           | No Interference |                 |
| HLRS 4040-05-240  |                           |                  | 24                     | 24.96                               | 25.76           | 26.60           | 27.51           | No Interference |                 |
| HLRS 4040-05-320  |                           |                  | 32                     | 33.21                               | 34.27           | 35.41           | No Interference | No Interference |                 |
| HLRS 4040-05-400  |                           |                  | 40                     | 41.46                               | 42.79           | No Interference | No Interference | No Interference |                 |
| HLRS 4040-05-480  |                           |                  | 48                     | 49.71                               | 51.31           | No Interference | No Interference | No Interference |                 |
| HLRS 4040-10-080  |                           | R1               | 8                      | 8.44                                | 8.69            | 8.95            | 9.22            | 9.84            |                 |
| HLRS 4040-10-120  |                           |                  | 12                     | 12.57                               | 12.94           | 13.35           | 13.78           | 14.74           |                 |
| HLRS 4040-10-160  |                           |                  | 16                     | 16.69                               | 17.20           | 17.75           | 18.33           | 19.63           |                 |
| HLRS 4040-10-200  |                           |                  | 20                     | 20.82                               | 21.46           | 22.15           | 22.89           | No Interference |                 |
| HLRS 4040-10-240  |                           |                  | 24                     | 24.94                               | 25.72           | 26.55           | 27.44           | No Interference |                 |
| HLRS 4040-10-320  |                           |                  | 32                     | 33.20                               | 34.24           | 35.36           | No Interference | No Interference |                 |
| HLRS 4040-10-480  |                           |                  | 48                     | 49.70                               | 51.28           | No Interference | No Interference | No Interference |                 |
| HLRS 4050-005-160 |                           |                  | 5                      | RO.05                               | 16              | 16.73           | 17.27           | 17.85           | No Interference |
| HLRS 4050-005-200 |                           | 20               |                        |                                     | 20.85           | 21.53           | No Interference | No Interference | No Interference |
| HLRS 4050-005-400 |                           | 40               |                        |                                     | 41.48           | No Interference | No Interference | No Interference | No Interference |
| HLRS 4050-01-160  |                           | RO.1             |                        | 16                                  | 16.72           | 17.27           | 17.84           | No Interference | No Interference |
| HLRS 4050-01-200  |                           |                  |                        | 20                                  | 20.85           | 21.52           | No Interference | No Interference | No Interference |
| HLRS 4050-01-400  | 40                        |                  |                        | 41.48                               | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 4050-02-160  | RO.2                      | 16               |                        | 16.72                               | 17.26           | 17.83           | No Interference | No Interference |                 |
| HLRS 4050-02-200  |                           | 20               |                        | 20.85                               | 21.52           | No Interference | No Interference | No Interference |                 |
| HLRS 4050-02-400  |                           | 40               |                        | 41.47                               | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 4050-03-160  | RO.3                      | 16               |                        | 16.72                               | 17.25           | 17.82           | No Interference | No Interference |                 |
| HLRS 4050-03-200  |                           | 20               |                        | 20.84                               | 21.51           | No Interference | No Interference | No Interference |                 |
| HLRS 4050-03-400  |                           | 40               |                        | 41.47                               | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 4050-05-160  | RO.5                      | 16               |                        | 16.71                               | 17.24           | 17.80           | No Interference | No Interference |                 |
| HLRS 4050-05-200  |                           | 20               |                        | 20.83                               | 21.50           | No Interference | No Interference | No Interference |                 |
| HLRS 4050-05-400  |                           | 40               |                        | 41.46                               | No Interference | No Interference | No Interference | No Interference |                 |
| HLRS 4050-10-160  | R1                        | 16               |                        | 16.69                               | 17.20           | 17.74           | No Interference | No Interference |                 |
| HLRS 4050-10-200  |                           | 20               |                        | 20.81                               | 21.46           | No Interference | No Interference | No Interference |                 |
| HLRS 4050-10-400  |                           | 40               |                        | 41.44                               | No Interference | No Interference | No Interference | No Interference |                 |

4 Flutes

$\phi 3\text{mm}$  Shank V Series

UDC-PCD Series

CBN Series

Square

Square

Long Neck Square

Radius

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Ball

Long Neck Ball

Taper Neck Ball

Taper

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |        |
|-------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|--------|
| HLRS 4060-005-120 | 6                         | RO.05            | 12                        | 4.8                  | 5.82                     | —                     | 65               | 6                       | 15,400                   |        |
| HLRS 4060-005-160 |                           |                  | 16                        |                      |                          |                       | 65               | 6                       | 15,400                   |        |
| HLRS 4060-005-200 |                           |                  | 20                        |                      |                          |                       | 70               | 6                       | 15,400                   |        |
| HLRS 4060-005-240 |                           |                  | 24                        |                      |                          |                       | 70               | 6                       | 15,400                   |        |
| HLRS 4060-005-300 |                           |                  | 30                        |                      |                          |                       | 100              | 6                       | 18,000                   |        |
| HLRS 4060-005-480 |                           |                  | 48                        |                      |                          |                       | 120              | 6                       | 24,000                   |        |
| HLRS 4060-01-120  |                           | RO.1             | 12                        |                      |                          |                       | 65               | 6                       | 15,400                   |        |
| HLRS 4060-01-160  |                           |                  | 16                        |                      |                          |                       | 65               | 6                       | 15,400                   |        |
| HLRS 4060-01-180  |                           |                  | 18                        |                      |                          |                       | 70               | 6                       | 15,400                   |        |
| HLRS 4060-01-200  |                           |                  | 20                        |                      |                          |                       | 70               | 6                       | 15,400                   |        |
| HLRS 4060-01-240  |                           |                  | 24                        |                      |                          |                       | 70               | 6                       | 15,400                   |        |
| HLRS 4060-01-300  |                           |                  | 30                        |                      |                          |                       | 100              | 6                       | 18,000                   |        |
| HLRS 4060-01-480  |                           |                  | 48                        |                      |                          |                       | 120              | 6                       | 24,000                   |        |
| HLRS 4060-02-120  |                           |                  | RO.2                      |                      |                          |                       | 12               | 65                      | 6                        | 15,400 |
| HLRS 4060-02-160  |                           |                  |                           |                      |                          |                       | 16               | 65                      | 6                        | 15,400 |
| HLRS 4060-02-180  |                           |                  |                           |                      |                          |                       | 18               | 70                      | 6                        | 15,400 |
| HLRS 4060-02-200  |                           |                  |                           |                      |                          |                       | 20               | 70                      | 6                        | 15,400 |
| HLRS 4060-02-240  |                           |                  |                           |                      |                          |                       | 24               | 70                      | 6                        | 15,400 |
| HLRS 4060-02-300  |                           | 30               |                           |                      |                          |                       | 100              | 6                       | 18,000                   |        |
| HLRS 4060-02-480  |                           | 48               | 120                       |                      |                          |                       | 6                | 24,000                  |                          |        |
| HLRS 4060-03-120  |                           | RO.3             | 12                        |                      |                          |                       | 65               | 6                       | 15,400                   |        |
| HLRS 4060-03-160  |                           |                  | 16                        |                      |                          |                       | 65               | 6                       | 15,400                   |        |
| HLRS 4060-03-180  |                           |                  | 18                        |                      |                          |                       | 70               | 6                       | 15,400                   |        |
| HLRS 4060-03-200  |                           |                  | 20                        |                      |                          |                       | 70               | 6                       | 15,400                   |        |
| HLRS 4060-03-240  |                           |                  | 24                        |                      |                          |                       | 70               | 6                       | 15,400                   |        |
| HLRS 4060-03-300  |                           |                  | 30                        |                      |                          |                       | 100              | 6                       | 18,000                   |        |
| HLRS 4060-03-480  |                           | 48               | 120                       |                      |                          |                       | 6                | 24,000                  |                          |        |
| HLRS 4060-05-120  |                           | RO.5             | 12                        |                      |                          |                       | 65               | 6                       | 15,400                   |        |
| HLRS 4060-05-160  |                           |                  | 16                        |                      |                          |                       | 65               | 6                       | 15,400                   |        |
| HLRS 4060-05-180  |                           |                  | 18                        |                      |                          |                       | 70               | 6                       | 15,400                   |        |
| HLRS 4060-05-200  |                           |                  | 20                        |                      |                          |                       | 70               | 6                       | 15,400                   |        |
| HLRS 4060-05-240  |                           |                  | 24                        |                      |                          |                       | 70               | 6                       | 15,400                   |        |
| HLRS 4060-05-300  |                           |                  | 30                        |                      |                          |                       | 100              | 6                       | 18,000                   |        |
| HLRS 4060-05-400  |                           |                  | 40                        |                      |                          |                       | 100              | 6                       | 18,000                   |        |
| HLRS 4060-05-480  |                           |                  | 48                        |                      |                          |                       | 120              | 6                       | 24,000                   |        |
| HLRS 4060-10-120  |                           |                  | R1                        |                      |                          |                       | 12               | 65                      | 6                        | 15,400 |
| HLRS 4060-10-160  |                           |                  |                           |                      |                          |                       | 16               | 65                      | 6                        | 15,400 |
| HLRS 4060-10-180  |                           |                  |                           |                      |                          |                       | 18               | 70                      | 6                        | 15,400 |
| HLRS 4060-10-200  |                           |                  |                           |                      |                          |                       | 20               | 70                      | 6                        | 15,400 |
| HLRS 4060-10-240  |                           | 24               |                           |                      |                          |                       | 70               | 6                       | 15,400                   |        |
| HLRS 4060-10-300  |                           | 30               |                           |                      |                          |                       | 100              | 6                       | 18,000                   |        |
| HLRS 4060-10-400  |                           | 40               |                           |                      |                          |                       | 100              | 6                       | 18,000                   |        |
| HLRS 4060-10-480  |                           | 48               |                           |                      |                          |                       | 120              | 6                       | 24,000                   |        |

$\phi 3$ mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|-------------------|---------------------------|------------------|------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|                   |                           |                  |                        | 30'                                 | 1°              | 1°30'           | 2°              | 3°              |
| HLRS 4060-005-120 | 6                         | RO.05            | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-005-160 |                           |                  | 16                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-005-200 |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-005-240 |                           |                  | 24                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-005-300 |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-005-480 |                           |                  | 48                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-01-120  |                           | RO.1             | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-01-160  |                           |                  | 16                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-01-180  |                           |                  | 18                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-01-200  |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-01-240  |                           |                  | 24                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-01-300  |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-01-480  |                           | 48               | No Interference        | No Interference                     | No Interference | No Interference | No Interference |                 |
| HLRS 4060-02-120  |                           | RO.2             | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-02-160  |                           |                  | 16                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-02-180  |                           |                  | 18                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-02-200  |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-02-240  |                           |                  | 24                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-02-300  |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-02-480  |                           | 48               | No Interference        | No Interference                     | No Interference | No Interference | No Interference |                 |
| HLRS 4060-03-120  |                           | RO.3             | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-03-160  |                           |                  | 16                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-03-180  |                           |                  | 18                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-03-200  |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-03-240  |                           |                  | 24                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-03-300  |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-03-480  |                           | 48               | No Interference        | No Interference                     | No Interference | No Interference | No Interference |                 |
| HLRS 4060-05-120  |                           | RO.5             | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-05-160  |                           |                  | 16                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-05-180  |                           |                  | 18                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-05-200  |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-05-240  |                           |                  | 24                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-05-300  |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-05-400  |                           | 40               | No Interference        | No Interference                     | No Interference | No Interference | No Interference |                 |
| HLRS 4060-05-480  |                           | 48               | No Interference        | No Interference                     | No Interference | No Interference | No Interference |                 |
| HLRS 4060-10-120  |                           | R1               | 12                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-10-160  |                           |                  | 16                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-10-180  |                           |                  | 18                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-10-200  |                           |                  | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-10-240  |                           |                  | 24                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-10-300  |                           |                  | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HLRS 4060-10-400  |                           | 40               | No Interference        | No Interference                     | No Interference | No Interference | No Interference |                 |
| HLRS 4060-10-480  |                           | 48               | No Interference        | No Interference                     | No Interference | No Interference | No Interference |                 |

4 Flutes

$\phi 3$ mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Milling Conditions for HLRS (4 Flutes)

| WORK MATERIAL |                       |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD (30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKH<br>(55~65HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4002          | 0.2                   | 0.3                   | 27,000  | 620                | 0.005                           | 0.05                             | 27,000                                     | 500                | 0.003                           | 0.04                             | 27,000                                     | 390                | 0.003                           | 0.01                             |
|               |                       | 0.5                   | 24,000  | 500                | 0.005                           | 0.05                             | 24,000                                     | 410                | 0.003                           | 0.04                             | 24,000                                     | 250                | 0.003                           | 0.01                             |
|               |                       | 1                     | 21,000  | 380                | 0.004                           | 0.05                             | 21,000                                     | 320                | 0.002                           | 0.04                             | 21,000                                     | 110                | 0.002                           | 0.009                            |
|               |                       | 1.5                   | 18,000  | 260                | 0.004                           | 0.05                             | 18,000                                     | 240                | 0.002                           | 0.03                             | 18,000                                     | 80                 | 0.002                           | 0.007                            |
|               |                       | 2                     | 15,000  | 140                | 0.004                           | 0.05                             | 15,000                                     | 160                | 0.002                           | 0.03                             | 15,000                                     | 60                 | 0.002                           | 0.007                            |
| 4003          | 0.3                   | 0.3                   | 24,500  | 660                | 0.01                            | 0.075                            | 23,700                                     | 530                | 0.006                           | 0.07                             | 20,000                                     | 330                | 0.003                           | 0.028                            |
|               |                       | 0.5                   | 23,300  | 600                | 0.008                           | 0.075                            | 22,500                                     | 490                | 0.006                           | 0.07                             | 18,500                                     | 270                | 0.003                           | 0.028                            |
|               |                       | 1                     | 20,400  | 460                | 0.006                           | 0.075                            | 19,500                                     | 400                | 0.005                           | 0.07                             | 17,000                                     | 180                | 0.003                           | 0.028                            |
|               |                       | 1.5                   | 17,500  | 320                | 0.004                           | 0.05                             | 16,500                                     | 310                | 0.005                           | 0.07                             | 16,000                                     | 140                | 0.003                           | 0.025                            |
| 4004          | 0.4                   | 0.5                   | 25,400  | 870                | 0.015                           | 0.12                             | 22,500                                     | 750                | 0.011                           | 0.1                              | 16,200                                     | 360                | 0.003                           | 0.05                             |
|               |                       | 1                     | 22,600  | 700                | 0.012                           | 0.12                             | 20,500                                     | 600                | 0.009                           | 0.1                              | 15,000                                     | 250                | 0.003                           | 0.045                            |
|               |                       | 1.5                   | 21,200  | 610                | 0.01                            | 0.12                             | 19,500                                     | 520                | 0.008                           | 0.095                            | 14,400                                     | 150                | 0.003                           | 0.043                            |
| 4005          | 0.5                   | 1                     | 22,000  | 800                | 0.017                           | 0.155                            | 20,000                                     | 670                | 0.012                           | 0.125                            | 13,500                                     | 300                | 0.003                           | 0.065                            |
|               |                       | 2                     | 19,300  | 610                | 0.013                           | 0.155                            | 18,000                                     | 530                | 0.01                            | 0.12                             | 12,300                                     | 170                | 0.003                           | 0.06                             |
| 4006          | 0.6                   | 2                     | 21,300  | 900                | 0.018                           | 0.17                             | 19,000                                     | 750                | 0.015                           | 0.145                            | 11,500                                     | 240                | 0.003                           | 0.083                            |
|               |                       | 4                     | 18,600  | 690                | 0.013                           | 0.17                             | 15,500                                     | 520                | 0.013                           | 0.14                             | 10,300                                     | 50                 | 0.003                           | 0.07                             |
| 4008          | 0.8                   | 2                     | 20,000  | 1,100              | 0.025                           | 0.2                              | 18,500                                     | 950                | 0.02                            | 0.2                              | 10,000                                     | 280                | 0.005                           | 0.12                             |
|               |                       | 3                     | 18,800  | 950                | 0.021                           | 0.2                              | 16,500                                     | 830                | 0.018                           | 0.2                              | 9,200                                      | 200                | 0.005                           | 0.116                            |
|               |                       | 4                     | 17,500  | 840                | 0.018                           | 0.2                              | 15,000                                     | 730                | 0.016                           | 0.2                              | 8,800                                      | 120                | 0.004                           | 0.112                            |
|               |                       | 6                     | 14,600  | 700                | 0.015                           | 0.2                              | 12,500                                     | 600                | 0.015                           | 0.2                              | 8,500                                      | 60                 | 0.004                           | 0.108                            |
| 4010          | 1                     | 8                     | 13,100  | 450                | 0.008                           | 0.13                             | 11,150                                     | 425                | 0.008                           | 0.125                            | 7,500                                      | 50                 | 0.003                           | 0.057                            |
|               |                       | 2                     | 17,600  | 1,470              | 0.056                           | 0.27                             | 15,300                                     | 1,200              | 0.038                           | 0.27                             | 10,900                                     | 710                | 0.03                            | 0.27                             |
|               |                       | 3                     | 15,500  | 1,390              | 0.048                           | 0.27                             | 13,200                                     | 1,150              | 0.037                           | 0.27                             | 9,400                                      | 680                | 0.027                           | 0.27                             |
|               |                       | 4                     | 13,800  | 1,310              | 0.039                           | 0.27                             | 12,000                                     | 1,070              | 0.031                           | 0.243                            | 8,500                                      | 640                | 0.015                           | 0.243                            |
|               |                       | 5                     | 12,500  | 1,150              | 0.03                            | 0.24                             | 11,000                                     | 960                | 0.027                           | 0.232                            | 7,800                                      | 570                | 0.013                           | 0.144                            |
|               |                       | 6                     | 11,300  | 1,040              | 0.021                           | 0.216                            | 9,800                                      | 860                | 0.016                           | 0.209                            | 7,000                                      | 510                | 0.01                            | 0.108                            |
|               |                       | 8                     | 9,800   | 780                | 0.02                            | 0.189                            | 8,500                                      | 720                | 0.012                           | 0.16                             | 6,100                                      | 420                | 0.008                           | 0.094                            |
|               |                       | 10                    | 8,800   | 510                | 0.011                           | 0.126                            | 7,600                                      | 510                | 0.009                           | 0.1                              | 5,400                                      | 350                | 0.006                           | 0.05                             |
| 4012          | 1.2                   | 12                    | 8,100   | 320                | 0.008                           | 0.1                              | 7,000                                      | 400                | 0.006                           | 0.05                             | 5,000                                      | 300                | 0.006                           | 0.03                             |
|               |                       | 16                    | 7,000   | 150                | 0.005                           | 0.06                             | 6,100                                      | 330                | 0.006                           | 0.05                             | 4,300                                      | 250                | 0.005                           | 0.01                             |
|               |                       | 4                     | 13,200  | 1,360              | 0.032                           | 0.45                             | 11,900                                     | 1,100              | 0.024                           | 0.3                              | 9,200                                      | 1,300              | 0.02                            | 0.2                              |
| 4015          | 1.5                   | 6                     | 11,200  | 1,160              | 0.028                           | 0.36                             | 9,600                                      | 980                | 0.022                           | 0.252                            | 7,400                                      | 1,200              | 0.011                           | 0.095                            |
|               |                       | 10                    | 9,000   | 800                | 0.017                           | 0.18                             | 7,300                                      | 600                | 0.009                           | 0.15                             | 6,300                                      | 800                | 0.006                           | 0.05                             |
|               |                       | 3                     | 16,400  | 1,520              | 0.063                           | 0.569                            | 14,800                                     | 1,330              | 0.052                           | 0.54                             | 11,200                                     | 780                | 0.035                           | 0.315                            |
|               |                       | 4                     | 13,200  | 1,360              | 0.054                           | 0.54                             | 13,200                                     | 1,280              | 0.042                           | 0.495                            | 10,100                                     | 700                | 0.033                           | 0.292                            |
|               |                       | 6                     | 11,600  | 1,280              | 0.041                           | 0.486                            | 10,600                                     | 1,210              | 0.038                           | 0.445                            | 8,100                                      | 460                | 0.025                           | 0.202                            |
|               |                       | 8                     | 10,200  | 1,080              | 0.037                           | 0.378                            | 9,300                                      | 1,020              | 0.031                           | 0.346                            | 7,100                                      | 390                | 0.015                           | 0.157                            |
|               |                       | 10                    | 9,300   | 930                | 0.032                           | 0.345                            | 8,500                                      | 870                | 0.029                           | 0.316                            | 6,600                                      | 340                | 0.011                           | 0.172                            |
|               |                       | 12                    | 8,500   | 830                | 0.029                           | 0.324                            | 7,800                                      | 780                | 0.026                           | 0.297                            | 5,900                                      | 300                | 0.01                            | 0.162                            |
| 4018          | 1.8                   | 16                    | 7,400   | 670                | 0.018                           | 0.216                            | 6,800                                      | 600                | 0.014                           | 0.198                            | 5,100                                      | 230                | 0.005                           | 0.108                            |
|               |                       | 18                    | 6,000   | 550                | 0.015                           | 0.2                              | 5,800                                      | 420                | 0.01                            | 0.15                             | 4,200                                      | 150                | 0.005                           | 0.08                             |
|               |                       | 8                     | 10,700  | 1,120              | 0.047                           | 0.495                            | 9,800                                      | 1,060              | 0.043                           | 0.497                            | 7,700                                      | 500                | 0.02                            | 0.222                            |
|               |                       | 10                    | 9,600   | 1,010              | 0.04                            | 0.436                            | 8,900                                      | 950                | 0.038                           | 0.421                            | 7,100                                      | 390                | 0.015                           | 0.203                            |
|               |                       | 12                    | 8,100   | 850                | 0.035                           | 0.303                            | 7,500                                      | 740                | 0.032                           | 0.306                            | 5,900                                      | 290                | 0.013                           | 0.159                            |
|               |                       | 14                    | 7,400   | 770                | 0.027                           | 0.24                             | 6,900                                      | 660                | 0.024                           | 0.24                             | 5,400                                      | 270                | 0.008                           | 0.13                             |
|               |                       | 16                    | 7,200   | 730                | 0.021                           | 0.207                            | 6,700                                      | 630                | 0.019                           | 0.198                            | 5,200                                      | 260                | 0.006                           | 0.113                            |

## Milling Conditions for HLRS (4 Flutes)

| WORK MATERIAL |                       |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD (30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKH<br>(55~65HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>r</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>r</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>r</sub> Radial Depth (mm) |
| 4020          | 2                     | 4                     | 15,300  | 1,570              | 0.069                           | 0.72                             | 14,300                                     | 1,460              | 0.065                           | 0.81                             | 11,500                                     | 860                | 0.031                           | 0.36                             |
|               |                       | 6                     | 12,800  | 1,280              | 0.064                           | 0.648                            | 12,000                                     | 1,200              | 0.06                            | 0.729                            | 9,700                                      | 700                | 0.028                           | 0.324                            |
|               |                       | 8                     | 11,200  | 1,160              | 0.058                           | 0.612                            | 10,400                                     | 1,100              | 0.055                           | 0.648                            | 8,400                                      | 600                | 0.026                           | 0.288                            |
|               |                       | 10                    | 10,000  | 1,090              | 0.049                           | 0.526                            | 9,300                                      | 1,020              | 0.047                           | 0.526                            | 7,600                                      | 450                | 0.019                           | 0.234                            |
|               |                       | 12                    | 9,100   | 1,030              | 0.046                           | 0.405                            | 8,500                                      | 960                | 0.044                           | 0.405                            | 6,900                                      | 420                | 0.018                           | 0.18                             |
|               |                       | 16                    | 7,800   | 860                | 0.042                           | 0.283                            | 7,300                                      | 700                | 0.039                           | 0.315                            | 5,900                                      | 270                | 0.016                           | 0.157                            |
|               |                       | 20                    | 7,000   | 800                | 0.025                           | 0.198                            | 6,600                                      | 650                | 0.024                           | 0.198                            | 5,300                                      | 290                | 0.007                           | 0.118                            |
|               |                       | 24                    | 6,500   | 740                | 0.02                            | 0.17                             | 5,600                                      | 500                | 0.019                           | 0.14                             | 4,700                                      | 270                | 0.007                           | 0.1                              |
|               |                       | 26                    | 6,000   | 680                | 0.013                           | 0.15                             | 5,000                                      | 440                | 0.012                           | 0.12                             | 4,000                                      | 220                | 0.005                           | 0.08                             |
| 30            | 5,500                 | 620                   | 0.01  | 0.1                | 4,400                           | 390                              | 0.009                                      | 0.09               | 3,400                           | 180                              | 0.005                                      | 0.08               |                                 |                                  |
| 4025          | 2.5                   | 6                     | 13,000  | 1,600              | 0.078                           | 0.7                              | 12,000                                     | 1,500              | 0.074                           | 0.7                              | 9,900                                      | 830                | 0.05                            | 0.476                            |
|               |                       | 8                     | 11,300  | 1,430              | 0.075                           | 0.62                             | 10,500                                     | 1,240              | 0.072                           | 0.62                             | 9,100                                      | 650                | 0.05                            | 0.42                             |
|               |                       | 10                    | 10,500  | 1,400              | 0.067                           | 0.54                             | 10,000                                     | 1,150              | 0.067                           | 0.54                             | 8,400                                      | 510                | 0.048                           | 0.324                            |
|               |                       | 16                    | 8,900   | 1,400              | 0.059                           | 0.36                             | 8,500                                      | 790                | 0.049                           | 0.3                              | 7,200                                      | 350                | 0.03                            | 0.15                             |
|               |                       | 20                    | 7,800   | 1,200              | 0.048                           | 0.27                             | 7,500                                      | 670                | 0.031                           | 0.225                            | 6,300                                      | 300                | 0.022                           | 0.09                             |
| 30            | 6,300                 | 600                   | 0.011   | 0.18               | 6,000                           | 500                              | 0.014                                      | 0.18               | 5,000                           | 220                              | 0.01                                       | 0.054              |                                 |                                  |
| 4030          | 3                     | 4                     | 15,000  | 3,070              | 0.128                           | 0.72                             | 14,000                                     | 2,640              | 0.08                            | 0.72                             | 11,500                                     | 980                | 0.052                           | 0.576                            |
|               |                       | 6                     | 14,000  | 2,890              | 0.12                            | 0.72                             | 13,300                                     | 2,500              | 0.075                           | 0.72                             | 10,800                                     | 900                | 0.05                            | 0.576                            |
|               |                       | 8                     | 12,500  | 2,530              | 0.105                           | 0.7                              | 11,800                                     | 2,200              | 0.07                            | 0.7                              | 9,900                                      | 810                | 0.047                           | 0.56                             |
|               |                       | 10                    | 11,300  | 2,160              | 0.096                           | 0.7                              | 10,500                                     | 2,090              | 0.06                            | 0.7                              | 9,000                                      | 730                | 0.045                           | 0.56                             |
|               |                       | 12                    | 10,500  | 2,020              | 0.084                           | 0.67                             | 10,000                                     | 1,950              | 0.052                           | 0.67                             | 8,100                                      | 660                | 0.037                           | 0.502                            |
|               |                       | 14                    | 9,700   | 1,800              | 0.072                           | 0.65                             | 9,300                                      | 1,700              | 0.044                           | 0.65                             | 7,500                                      | 600                | 0.032                           | 0.43                             |
|               |                       | 16                    | 9,200   | 1,680              | 0.064                           | 0.63                             | 8,800                                      | 1,600              | 0.04                            | 0.63                             | 7,100                                      | 570                | 0.027                           | 0.378                            |
|               |                       | 18                    | 8,600   | 1,610              | 0.061                           | 0.605                            | 8,300                                      | 1,540              | 0.038                           | 0.605                            | 6,700                                      | 560                | 0.023                           | 0.348                            |
|               |                       | 20                    | 8,400   | 1,540              | 0.058                           | 0.58                             | 7,900                                      | 1,490              | 0.036                           | 0.58                             | 6,300                                      | 550                | 0.022                           | 0.319                            |
|               |                       | 24                    | 7,900   | 1,490              | 0.052                           | 0.513                            | 7,500                                      | 1,420              | 0.029                           | 0.513                            | 6,000                                      | 510                | 0.017                           | 0.258                            |
|               |                       | 26                    | 7,500   | 1,440              | 0.046                           | 0.446                            | 7,100                                      | 1,360              | 0.023                           | 0.446                            | 5,700                                      | 480                | 0.012                           | 0.198                            |
|               |                       | 30                    | 7,000   | 1,260              | 0.04                            | 0.38                             | 6,500                                      | 1,230              | 0.015                           | 0.38                             | 5,400                                      | 390                | 0.007                           | 0.144                            |
| 36            | 6,500                 | 1,100                 | 0.035   | 0.3                | 6,100                           | 1,110                            | 0.01                                       | 0.18               | 5,100                           | 300                              | 0.005                                      | 0.1                |                                 |                                  |
| 4040          | 4                     | 8                     | 10,200  | 1,480              | 0.133                           | 1.35                             | 8,500                                      | 1,420              | 0.104                           | 1.35                             | 7,300                                      | 810                | 0.091                           | 0.945                            |
|               |                       | 12                    | 8,900   | 1,440              | 0.116                           | 1.15                             | 7,600                                      | 1,390              | 0.091                           | 1.15                             | 6,400                                      | 780                | 0.065                           | 0.805                            |
|               |                       | 14                    | 8,500   | 1,400              | 0.1                             | 1.08                             | 7,100                                      | 1,350              | 0.078                           | 1.08                             | 6,000                                      | 760                | 0.051                           | 0.76                             |
|               |                       | 16                    | 7,900   | 1,370              | 0.091                           | 1                                | 6,600                                      | 1,330              | 0.071                           | 1                                | 5,600                                      | 740                | 0.043                           | 0.7                              |
|               |                       | 20                    | 6,900   | 1,320              | 0.076                           | 0.9                              | 5,800                                      | 1,260              | 0.059                           | 0.9                              | 4,900                                      | 720                | 0.032                           | 0.63                             |
|               |                       | 24                    | 6,200   | 1,200              | 0.06                            | 0.8                              | 5,200                                      | 1,120              | 0.047                           | 0.8                              | 4,500                                      | 630                | 0.022                           | 0.56                             |
|               |                       | 32                    | 5,500   | 960                | 0.037                           | 0.648                            | 4,600                                      | 920                | 0.029                           | 0.648                            | 3,900                                      | 600                | 0.011                           | 0.388                            |
|               |                       | 40                    | 5,000   | 790                | 0.025                           | 0.55                             | 4,300                                      | 800                | 0.02                            | 0.482                            | 3,600                                      | 560                | 0.008                           | 0.3                              |
|               |                       | 48                    | 4,600   | 700                | 0.012                           | 0.45                             | 3,900                                      | 680                | 0.01                            | 0.315                            | 3,300                                      | 500                | 0.005                           | 0.1                              |
| 4050          | 5                     | 16                    | 7,200   | 1,700              | 0.15                            | 1.5                              | 5,300                                      | 1,200              | 0.125                           | 1.15                             | 4,200                                      | 820                | 0.063                           | 1.03                             |
|               |                       | 20                    | 6,700   | 1,500              | 0.14                            | 1.4                              | 4,800                                      | 1,100              | 0.1                             | 1.1                              | 4,000                                      | 740                | 0.045                           | 1                                |
|               |                       | 40                    | 4,600   | 880                | 0.068                           | 1                                | 3,300                                      | 700                | 0.06                            | 0.68                             | 2,800                                      | 500                | 0.025                           | 0.44                             |
| 4060          | 6                     | 12                    | 8,000   | 2,370              | 0.2                             | 2.43                             | 4,700                                      | 1,360              | 0.2                             | 1.35                             | 4,000                                      | 1,080              | 0.075                           | 1.35                             |
|               |                       | 16                    | 6,700   | 2,020              | 0.19                            | 2.394                            | 4,000                                      | 1,150              | 0.19                            | 1.33                             | 3,400                                      | 900                | 0.073                           | 1.33                             |
|               |                       | 18                    | 6,300   | 1,890              | 0.185                           | 2.376                            | 3,750                                      | 1,060              | 0.185                           | 1.32                             | 3,200                                      | 830                | 0.071                           | 1.32                             |
|               |                       | 20                    | 5,800   | 1,730              | 0.18                            | 2.358                            | 3,500                                      | 1,000              | 0.18                            | 1.31                             | 3,000                                      | 760                | 0.07                            | 1.31                             |
|               |                       | 24                    | 5,200   | 1,540              | 0.17                            | 2.322                            | 3,100                                      | 860                | 0.17                            | 1.29                             | 2,700                                      | 680                | 0.068                           | 1.29                             |
|               |                       | 30                    | 4,500   | 1,290              | 0.158                           | 2.268                            | 2,600                                      | 740                | 0.158                           | 1.26                             | 2,200                                      | 580                | 0.066                           | 1.26                             |
|               |                       | 40                    | 3,000   | 800                | 0.1                             | 1.35                             | 1,700                                      | 480                | 0.1                             | 0.75                             | 1,400                                      | 360                | 0.04                            | 0.55                             |
| 48            | 2,000                 | 510                   | 0.05  | 0.9                | 1,200                           | 330                              | 0.04                                       | 0.5                | 1,000                           | 240                              | 0.02                                       | 0.3                |                                 |                                  |

4 Flutes

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

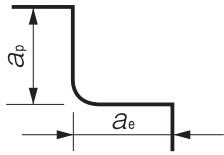
Barrel

Spiral  
V Cutter

Drill

Technical Data

## Side Milling



### Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Every coolant offers stable milling.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend wet coolant for Copper.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

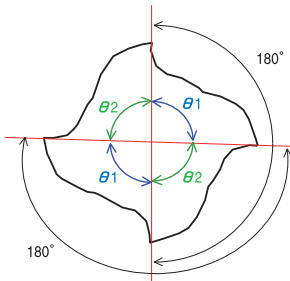
Spiral  
V Cutter

Drill

Technical Data

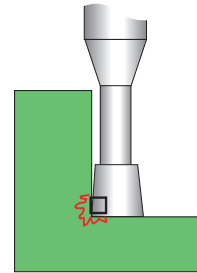


## Feature 1 : Variable pitch



$\theta 1 > \theta 2$  : The unequal division reduces chattering and tip damage.  
 $\theta 1 + \theta 2 = 180^\circ$  : Easy to measure outside diameter.

## Feature 2 : Back taper geometry



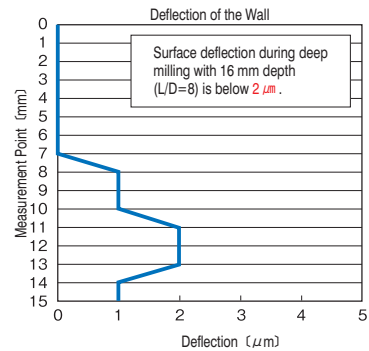
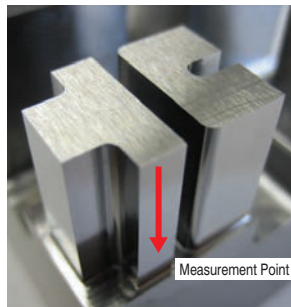
The back taper geometry reduces cutting resistance, which enables stable milling on vertical walls.

## Milling Example for Deep Milling

HLRS4000  $\phi 2 \times \text{CR0.3} \times \text{EL16}$  ( $L / D = 8$ )

DAC10 (48HRC)

|               |                              |
|---------------|------------------------------|
| Tool          | HLRS 4020-03-160             |
| Spindle Speed | 7,300 $\text{min}^{-1}$      |
| Feed Rate     | 1,260 $\text{mm}/\text{min}$ |
| $a_p$         | 0.02 $\text{mm}$             |
| $a_e$         | 0.015 $\text{mm}$            |
| Cycle Time    | 112 $\text{min}$             |
| Coolant       | Oil Mist                     |
| Work Size     | 20 $\times$ 15 $\text{mm}$   |



4 Flutes

$\phi 3\text{mm}$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 2 \sim \phi 12$

# HRRS

Super  
MG

HARD  
MAX

45°

R

$\pm 0.01$

$\pm 0.015$

Shank Dia  
0/-0.005

Back Taper  
Geometry

Variable  
Pitch

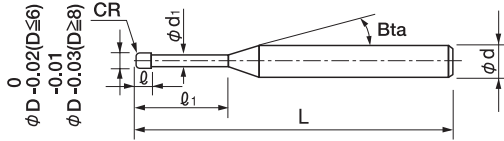
$\phi 2 \sim \phi 6$     $\phi 8 \sim \phi 12$

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 | ●                                | ●               | ●      | ●      | ○      |        | ○         |                 |          |        |          |                       |                 |                       |                  |                                       |

## Features

Special corner radius geometry offers greater milling amount and larger step over than a ball design. Seamless corner radius reduces cutting resistance and chattering. Suitable for milling hard materials up to 65HRC.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 49 models

Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| HRRS 4020-03-06   | 2                         | RO.3             | 6                         | 2                    | 1.91                     | 16°                   | 70               | 4                       | 10,500                   |
| HRRS 4020-05-06   |                           | RO.5             |                           |                      |                          |                       |                  |                         |                          |
| HRRS 4030-08-09-3 | 3                         | RO.8             | 9                         | 3                    | 2.92                     | —                     | 70               | 3                       | 9,800                    |
| HRRS 4030-08-09   |                           |                  |                           |                      |                          | 16°                   |                  |                         |                          |
| HRRS 4040-03-12-6 | 4                         | RO.3             | 12                        | 4                    | 3.82                     | 16°                   | 70               | 6                       | 11,600                   |
| HRRS 4040-03-20-6 |                           |                  | 20                        |                      |                          |                       | 70               |                         | 12,760                   |
| HRRS 4040-05-12   |                           | RO.5             | 12                        | 4                    | 3.82                     | —                     | 70               | 4                       | 10,000                   |
| HRRS 4040-05-12-6 |                           |                  |                           |                      |                          | 16°                   | 70               |                         | 6                        |
| HRRS 4040-05-20-6 |                           | R1               | 12                        | 4                    | 3.82                     | 16°                   | 70               | 6                       | 12,760                   |
| HRRS 4040-10-12   |                           |                  |                           |                      |                          |                       | —                |                         | 70                       |
| HRRS 4040-10-12-6 |                           | R1               | 12                        | 4                    | 3.82                     | 16°                   | 70               | 6                       | 11,600                   |
| HRRS 4040-10-20-6 |                           |                  |                           |                      |                          |                       | 70               |                         | 6                        |

Next Page ➡

Unit (mm)

| Model Number    | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|
| HRRS 4050-12-15 | 5                         | R1.2             | 15                        | 5                    | 4.82                     | 16°                       | 70               | 6                       | 12,000                   |
| HRRS 4060-03-18 | 6                         | R0.3             | 18                        | 6                    | 5.82                     | —                         | 90               | 6                       | 13,400                   |
| HRRS 4060-03-30 |                           |                  | 30                        |                      |                          |                           | 90               | 6                       | 14,740                   |
| HRRS 4060-05-18 |                           | R0.5             | 18                        |                      |                          |                           | 90               | 6                       | 13,400                   |
| HRRS 4060-05-30 |                           |                  | 30                        |                      |                          |                           | 90               | 6                       | 14,740                   |
| HRRS 4060-10-18 |                           | R1               | 18                        |                      |                          |                           | 90               | 6                       | 13,400                   |
| HRRS 4060-10-30 |                           |                  | 30                        |                      |                          |                           | 90               | 6                       | 14,740                   |
| HRRS 4060-15-18 |                           | R1.5             | 18                        |                      |                          |                           | 90               | 6                       | 13,400                   |
| HRRS 4060-15-30 |                           |                  | 30                        |                      |                          |                           | 90               | 6                       | 14,740                   |
| HRRS 4060-20-18 |                           | R2               | 18                        |                      |                          |                           | 90               | 6                       | 13,400                   |
| HRRS 4080-03-24 |                           | 8                | R0.3                      |                      |                          |                           | 24               | 8                       | 7.82                     |
| HRRS 4080-03-40 | 40                        |                  |                           | 100                  | 8                        | 18,370                    |                  |                         |                          |
| HRRS 4080-05-24 | R0.5                      |                  | 24                        | 100                  | 8                        | 16,700                    |                  |                         |                          |
| HRRS 4080-05-40 |                           |                  | 40                        | 100                  | 8                        | 18,370                    |                  |                         |                          |
| HRRS 4080-10-24 | R1                        |                  | 24                        | 100                  | 8                        | 16,700                    |                  |                         |                          |
| HRRS 4080-10-40 |                           |                  | 40                        | 100                  | 8                        | 18,370                    |                  |                         |                          |
| HRRS 4080-20-24 | R2                        |                  | 24                        | 100                  | 8                        | 16,700                    |                  |                         |                          |
| HRRS 4080-20-40 |                           |                  | 40                        | 100                  | 8                        | 18,370                    |                  |                         |                          |
| HRRS 4080-30-24 | R3                        |                  | 24                        | 100                  | 8                        | 16,700                    |                  |                         |                          |
| HRRS 4100-03-30 | 10                        |                  | R0.3                      | 30                   | 10                       | 9.82                      | —                |                         |                          |
| HRRS 4100-03-50 |                           | 50               |                           | 110                  |                          |                           |                  | 10                      | 24,200                   |
| HRRS 4100-05-30 |                           | R0.5             | 30                        | 110                  |                          |                           |                  | 10                      | 22,000                   |
| HRRS 4100-05-50 |                           |                  | 50                        | 110                  |                          |                           |                  | 10                      | 24,200                   |
| HRRS 4100-10-30 |                           | R1               | 30                        | 110                  |                          |                           |                  | 10                      | 22,000                   |
| HRRS 4100-10-50 |                           |                  | 50                        | 110                  |                          |                           |                  | 10                      | 24,200                   |
| HRRS 4100-20-30 |                           | R2               | 30                        | 110                  |                          |                           |                  | 10                      | 22,000                   |
| HRRS 4100-20-50 |                           |                  | 50                        | 110                  |                          |                           |                  | 10                      | 24,200                   |
| HRRS 4100-30-30 |                           | R3               | 30                        | 110                  |                          |                           |                  | 10                      | 22,000                   |
| HRRS 4120-03-36 |                           | 12               | R0.3                      | 36                   |                          |                           |                  | 12                      | 11.82                    |
| HRRS 4120-03-60 | 60                        |                  |                           | 120                  | 12                       | 30,470                    |                  |                         |                          |
| HRRS 4120-05-36 | R0.5                      |                  | 36                        | 120                  | 12                       | 27,700                    |                  |                         |                          |
| HRRS 4120-05-60 |                           |                  | 60                        | 120                  | 12                       | 30,470                    |                  |                         |                          |
| HRRS 4120-10-36 | R1                        |                  | 36                        | 120                  | 12                       | 27,700                    |                  |                         |                          |
| HRRS 4120-10-60 |                           |                  | 60                        | 120                  | 12                       | 30,470                    |                  |                         |                          |
| HRRS 4120-20-36 | R2                        |                  | 36                        | 120                  | 12                       | 27,700                    |                  |                         |                          |
| HRRS 4120-20-60 |                           |                  | 60                        | 120                  | 12                       | 30,470                    |                  |                         |                          |
| HRRS 4120-40-36 | R4                        |                  | 36                        | 120                  | 12                       | 27,700                    |                  |                         |                          |

4 Flutes

3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for HRRS / HRRS-S

◆Roughing Effective length 3D

| WORK MATERIAL |                       |                    | PREHARDENED STEELS / HARDENED STEELS (30~45HRC) (Air Blow / Oil Mist) |                    |                                 |                                  | HARDENED STEELS (45~55HRC) (Air Blow / Oil Mist) |                    |                                 |                                  | HARDENED STEELS (55~65HRC) (Air Blow / Oil Mist) |                    |                                 |                                  |
|---------------|-----------------------|--------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Spindle Speed (min <sup>-1</sup> )                                    | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )               | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )               | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4020-03-06    | 2                     | R0.3               | 30,000  | 7,650              | 0.03                            | 0.41                             | 10,000   | 2,160              | 0.08                            | 0.36                             | 8,000  | 1,170              | 0.04                            | 0.36                             |
| 4020-05-06    |                       | R0.5               | 30,000  | 7,650              | 0.05                            | 0.72                             | 10,000   | 2,160              | 0.14                            | 0.63                             | 8,000  | 1,170              | 0.07                            | 0.63                             |
| 4030-08-09    | 3                     | R0.8               | 25,000  | 8,100              | 0.07                            | 1.08                             | 10,000   | 2,970              | 0.16                            | 0.95                             | 7,000  | 1,710              | 0.09                            | 0.95                             |
| 4040-03-12-6  |                       | R0.3               | 15,000  | 8,550              | 0.05                            | 0.66                             | 9,000  | 3,600              | 0.08                            | 0.62                             | 6,000  | 2,160              | 0.04                            | 0.62                             |
| 4040-05-12    | 4                     | R0.5               | 15,000  | 8,550              | 0.06                            | 0.82                             | 9,000  | 3,600              | 0.1                             | 0.77                             | 6,000  | 2,160              | 0.05                            | 0.77                             |
| 4040-10-12    |                       | R1                 | 15,000  | 8,550              | 0.11                            | 1.44                             | 9,000  | 3,600              | 0.16                            | 1.35                             | 6,000  | 2,160              | 0.09                            | 1.35                             |
| 4050-12-15    | 5                     | R1.2               | 10,000  | 8,550              | 0.16                            | 1.8                              | 8,000  | 4,950              | 0.18                            | 1.58                             | 6,000  | 2,160              | 0.14                            | 1.58                             |
| 4060-03-18    |                       | R0.3               | 9,000   | 8,550              | 0.08                            | 0.98                             | 8,000  | 5,400              | 0.09                            | 0.87                             | 6,000  | 2,070              | 0.08                            | 0.87                             |
| 4060-05-18    | 6                     | R0.5               | 9,000   | 8,550              | 0.1                             | 1.23                             | 8,000  | 5,400              | 0.11                            | 1.08                             | 6,000  | 2,070              | 0.11                            | 1.08                             |
| 4060-10-18    |                       | R1                 | 9,000   | 8,550              | 0.14                            | 1.57                             | 8,000  | 5,400              | 0.14                            | 1.49                             | 6,000  | 2,070              | 0.14                            | 1.49                             |
| 4060-15-18    | 8                     | R1.5               | 9,000   | 8,550              | 0.17                            | 2.16                             | 8,000  | 5,400              | 0.18                            | 1.89                             | 6,000  | 2,070              | 0.18                            | 1.89                             |
| 4060-20-18    |                       | R2                 | 9,000   | 8,550              | 0.17                            | 2.3                              | 8,000  | 5,400              | 0.18                            | 2.02                             | 6,000  | 2,070              | 0.18                            | 2.02                             |
| 4080-03-24    | 8                     | R0.3               | 7,000   | 8,550              | 0.03                            | 1.2                              | 6,000  | 5,850              | 0.04                            | 1.04                             | 4,000  | 2,070              | 0.03                            | 1.04                             |
| 4080-05-24    |                       | R0.5               | 7,000   | 8,550              | 0.04                            | 1.5                              | 6,000  | 5,850              | 0.05                            | 1.3                              | 4,000  | 2,070              | 0.04                            | 1.3                              |
| 4080-10-24    | 8                     | R1                 | 7,000   | 8,550              | 0.05                            | 1.92                             | 6,000  | 5,850              | 0.06                            | 1.8                              | 4,000  | 2,070              | 0.05                            | 1.8                              |
| 4080-20-24    |                       | R2                 | 7,000   | 8,550              | 0.21                            | 2.88                             | 6,000  | 5,850              | 0.23                            | 2.52                             | 4,000  | 2,070              | 0.18                            | 2.52                             |
| 4080-30-24    | 10                    | R3                 | 7,000   | 8,550              | 0.21                            | 3.09                             | 6,000  | 5,850              | 0.23                            | 2.7                              | 4,000  | 2,070              | 0.18                            | 2.7                              |
| 4100-03-30    |                       | R0.3               | 6,000   | 8,550              | 0.03                            | 1.6                              | 5,000  | 5,580              | 0.04                            | 1.3                              | 3,000  | 2,160              | 0.03                            | 1.3                              |
| 4100-05-30    | 10                    | R0.5               | 6,000   | 8,550              | 0.04                            | 2                                | 5,000  | 5,580              | 0.05                            | 1.62                             | 3,000  | 2,160              | 0.04                            | 1.62                             |
| 4100-10-30    |                       | R1                 | 6,000   | 8,550              | 0.06                            | 2.57                             | 5,000  | 5,580              | 0.07                            | 2.25                             | 3,000  | 2,160              | 0.05                            | 2.25                             |
| 4100-20-30    | 12                    | R2                 | 6,000   | 8,550              | 0.24                            | 3.6                              | 5,000  | 5,580              | 0.27                            | 3.15                             | 3,000  | 2,160              | 0.18                            | 3.15                             |
| 4100-30-30    |                       | R3                 | 6,000   | 8,550              | 0.24                            | 3.86                             | 5,000  | 5,580              | 0.27                            | 3.38                             | 3,000  | 2,160              | 0.18                            | 3.38                             |
| 4120-03-36    | 12                    | R0.3               | 5,000   | 8,550              | 0.04                            | 1.93                             | 4,000  | 7,290              | 0.04                            | 1.56                             | 2,000  | 2,250              | 0.03                            | 1.56                             |
| 4120-05-36    |                       | R0.5               | 5,000   | 8,550              | 0.05                            | 2.41                             | 4,000  | 7,290              | 0.05                            | 1.94                             | 2,000  | 2,250              | 0.04                            | 1.94                             |
| 4120-10-36    | 12                    | R1                 | 5,000   | 8,550              | 0.07                            | 3.09                             | 4,000  | 7,290              | 0.07                            | 2.7                              | 2,000  | 2,250              | 0.05                            | 2.7                              |
| 4120-20-36    |                       | R2                 | 5,000   | 8,550              | 0.27                            | 4.32                             | 4,000  | 7,290              | 0.27                            | 3.78                             | 2,000  | 2,250              | 0.18                            | 3.78                             |
| 4120-40-36    | 12                    | R4                 | 5,000   | 8,550              | 0.27                            | 4.63                             | 4,000  | 7,290              | 0.27                            | 4.05                             | 2,000  | 2,250              | 0.18                            | 4.05                             |

When using an effective length of 5D, or the protruding tool experiences an "overhang", then pay attention to the tool overhang coefficient below while referring to the milling parameter table.

\*Effective Length 5D: Effective Length (ℓ) ÷ Diameter (φD) = 5

D: φ2.0~3.0

| Overhang Length L/D | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Axial Depth (mm) | Radial Depth (mm) |
|---------------------|------------------------------------|--------------------|------------------|-------------------|
| ~φD×6               | ×1                                 | ×1                 | ×1               | ×1                |
| ~φD×7               | ×0.8                               | ×0.8               | ×0.8             | ×0.9              |
| ~φD×8               | ×0.7                               | ×0.7               | ×0.7             | ×0.9              |
| ~φD×9               | ×0.7                               | ×0.7               | ×0.6             | ×0.8              |
| ~φD×10              | ×0.6                               | ×0.6               | ×0.6             | ×0.7              |

D: φ8.0~12.0

| Overhang Length L/D | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Axial Depth (mm) | Radial Depth (mm) |
|---------------------|------------------------------------|--------------------|------------------|-------------------|
| ~φD×4               | ×1                                 | ×1                 | ×1               | ×1                |
| ~φD×5               | ×0.7                               | ×0.7               | ×0.7             | ×0.8              |
| ~φD×6               | ×0.5                               | ×0.5               | ×0.6             | ×0.7              |

D: φ4.0~6.0

| Overhang Length L/D | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Axial Depth (mm) | Radial Depth (mm) |
|---------------------|------------------------------------|--------------------|------------------|-------------------|
| ~φD×4               | ×1                                 | ×1                 | ×1               | ×1                |
| ~φD×5               | ×0.9                               | ×0.9               | ×0.9             | ×0.9              |
| ~φD×6               | ×0.8                               | ×0.8               | ×0.8             | ×0.9              |
| ~φD×7               | ×0.7                               | ×0.7               | ×0.6             | ×0.8              |
| ~φD×8               | ×0.5                               | ×0.5               | ×0.6             | ×0.7              |

D: Outside Diameter (mm) L: Overhang Length (mm)

## Milling Conditions for HRRS / HRRS-S

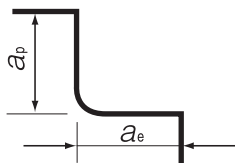
◆ Finishing (flat / inclined surface) Effective length 3D

| WORK MATERIAL |                       |                    | PREHARDENED STEELS / HARDENED STEELS (30~45HRC)<br>(Air Blow / Oil Mist) |                    |                        |                         | HARDENED STEELS (45~55HRC)<br>(Air Blow / Oil Mist) |                    |                        |                         | HARDENED STEELS (55~65HRC)<br>(Air Blow / Oil Mist) |                    |                        |                         |
|---------------|-----------------------|--------------------|--|--------------------|------------------------|-------------------------|---|--------------------|------------------------|-------------------------|---|--------------------|------------------------|-------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Spindle Speed (min <sup>-1</sup> )                                       | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 4020-03-06    | 2                     | R0.3               | 30,000   | 850                | 0.1                    | 0.03                    | 10,000  | 355                | 0.1                    | 0.04                    | 8,000   | 240                | 0.05                   | 0.03                    |
| 4020-05-06    |                       | R0.5               | 30,000   | 1,100              | 0.1                    | 0.04                    | 10,000  | 460                | 0.1                    | 0.05                    | 8,000   | 310                | 0.05                   | 0.04                    |
| 4030-08-09    | 3                     | R0.8               | 25,000   | 1,100              | 0.1                    | 0.04                    | 10,000  | 650                | 0.1                    | 0.07                    | 7,000   | 350                | 0.05                   | 0.05                    |
| 4040-03-12-6  |                       | R0.3               | 15,000   | 620                | 0.08                   | 0.04                    | 9,000   | 365                | 0.08                   | 0.04                    | 6,000   | 205                | 0.04                   | 0.03                    |
| 4040-05-12    | 4                     | R0.5               | 15,000   | 775                | 0.1                    | 0.05                    | 9,000   | 455                | 0.1                    | 0.05                    | 6,000   | 255                | 0.05                   | 0.04                    |
| 4040-10-12    |                       | R1                 | 15,000   | 1,100              | 0.1                    | 0.07                    | 9,000   | 650                | 0.1                    | 0.07                    | 6,000   | 360                | 0.05                   | 0.06                    |
| 4050-12-15    | 5                     | R1.2               | 10,000   | 1,100              | 0.1                    | 0.11                    | 8,000   | 650                | 0.1                    | 0.08                    | 6,000   | 360                | 0.05                   | 0.06                    |
| 4060-03-18    |                       | R0.3               | 9,000  | 550                | 0.16                   | 0.06                    | 8,000   | 300                | 0.16                   | 0.04                    | 6,000   | 170                | 0.08                   | 0.03                    |
| 4060-05-18    | 6                     | R0.5               | 9,000  | 690                | 0.2                    | 0.08                    | 8,000   | 375                | 0.2                    | 0.05                    | 6,000   | 215                | 0.1                    | 0.04                    |
| 4060-10-18    |                       | R1                 | 9,000  | 975                | 0.2                    | 0.11                    | 8,000   | 530                | 0.2                    | 0.07                    | 6,000   | 310                | 0.1                    | 0.05                    |
| 4060-15-18    |                       | R1.5               | 9,000  | 1,200              | 0.2                    | 0.13                    | 8,000   | 650                | 0.2                    | 0.08                    | 6,000   | 380                | 0.1                    | 0.06                    |
| 4060-20-18    |                       | R2                 | 9,000  | 1,385              | 0.2                    | 0.15                    | 8,000   | 750                | 0.2                    | 0.09                    | 6,000   | 435                | 0.1                    | 0.07                    |
| 4080-03-24    | 8                     | R0.3               | 7,000  | 480                | 0.04                   | 0.07                    | 6,000   | 260                | 0.04                   | 0.05                    | 4,000   | 145                | 0.04                   | 0.05                    |
| 4080-05-24    |                       | R0.5               | 7,000  | 598                | 0.05                   | 0.09                    | 6,000   | 322                | 0.05                   | 0.06                    | 4,000   | 184                | 0.05                   | 0.06                    |
| 4080-10-24    |                       | R1                 | 7,000  | 845                | 0.05                   | 0.12                    | 6,000   | 455                | 0.05                   | 0.08                    | 4,000   | 265                | 0.05                   | 0.07                    |
| 4080-20-24    |                       | R2                 | 7,000  | 1,200              | 0.2                    | 0.17                    | 6,000   | 650                | 0.2                    | 0.11                    | 4,000   | 380                | 0.1                    | 0.1                     |
| 4080-30-24    | 10                    | R3                 | 7,000  | 1,465              | 0.2                    | 0.21                    | 6,000   | 795                | 0.2                    | 0.13                    | 4,000   | 465                | 0.1                    | 0.12                    |
| 4100-03-30    |                       | R0.3               | 6,000  | 478                | 0.04                   | 0.08                    | 5,000   | 258                | 0.04                   | 0.05                    | 3,000   | 147                | 0.04                   | 0.06                    |
| 4100-05-30    |                       | R0.5               | 6,000  | 598                | 0.05                   | 0.1                     | 5,000   | 322                | 0.05                   | 0.06                    | 3,000   | 184                | 0.05                   | 0.07                    |
| 4100-10-30    |                       | R1                 | 6,000  | 845                | 0.05                   | 0.14                    | 5,000   | 455                | 0.05                   | 0.09                    | 3,000   | 265                | 0.05                   | 0.09                    |
| 4100-20-30    | 12                    | R2                 | 6,000  | 1,200              | 0.2                    | 0.2                     | 5,000   | 650                | 0.2                    | 0.13                    | 3,000   | 380                | 0.1                    | 0.13                    |
| 4100-30-30    |                       | R3                 | 6,000  | 1,470              | 0.2                    | 0.25                    | 5,000   | 795                | 0.2                    | 0.16                    | 3,000   | 465                | 0.1                    | 0.16                    |
| 4120-03-36    |                       | R0.3               | 5,000  | 480                | 0.04                   | 0.1                     | 4,000   | 260                | 0.04                   | 0.07                    | 2,000   | 145                | 0.04                   | 0.09                    |
| 4120-05-36    |                       | R0.5               | 5,000  | 598                | 0.05                   | 0.12                    | 4,000   | 322                | 0.05                   | 0.08                    | 2,000   | 184                | 0.05                   | 0.1                     |
| 4120-10-36    | 12                    | R1                 | 5,000  | 845                | 0.05                   | 0.17                    | 4,000   | 455                | 0.05                   | 0.11                    | 2,000   | 265                | 0.05                   | 0.13                    |
| 4120-20-36    |                       | R2                 | 5,000  | 1,200              | 0.2                    | 0.24                    | 4,000   | 650                | 0.2                    | 0.16                    | 2,000   | 380                | 0.1                    | 0.19                    |
| 4120-40-36    |                       | R4                 | 5,000  | 1,695              | 0.2                    | 0.34                    | 4,000   | 915                | 0.2                    | 0.23                    | 2,000   | 535                | 0.1                    | 0.27                    |

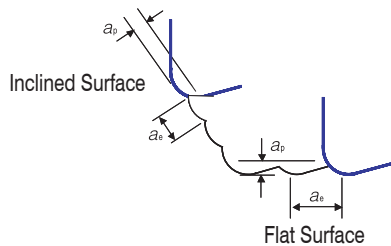
When using an effective length of 5D, or the protruding tool experiences an "overhang", then pay attention to the tool overhang coefficient found on page 384 while referring to the milling parameter table.

\*Effective Length 5D: Effective Length ( $\ell_e$ ) ÷ Diameter ( $\phi D$ ) = 5

Roughing Parameter



Finishing Parameter  
(Flat / Inclined Surface)



Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Only adjust the spindle speed when calculate milling conditions based on the overhang length in finishing process.
- Recommend air blow or oil mist.

4 Flutes

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

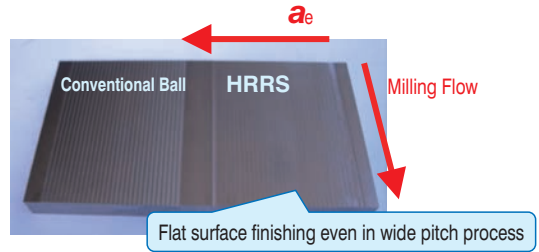
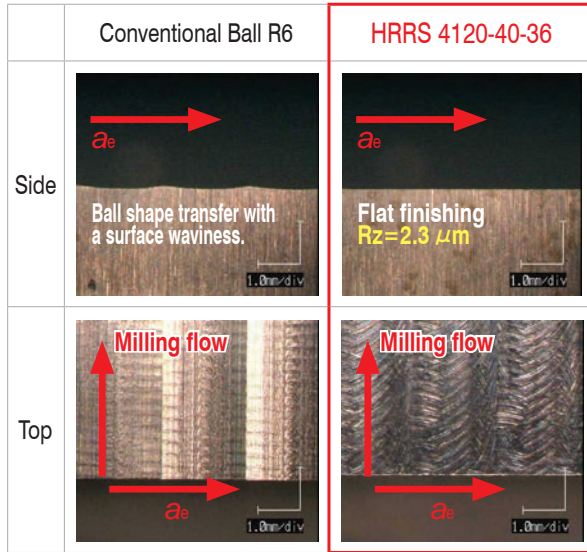
Spiral  
V Cutter

Drill

Technical Data

Flat Milling Example: Milling with HRRS  $\phi 12 \times \text{CR4}$

SKD11 (60HRC)



HRRS Surface Roughness  
Maximum Surface Roughness (calculated value) = 2.375  $\mu\text{m}$

| Spindle Speed           | Feed Rate  | $a_p$  | $a_e$ | Milling Distance         | Overhang Length |
|-------------------------|------------|--------|-------|--------------------------|-----------------|
| 2,000 $\text{min}^{-1}$ | 535 mm/min | 0.1 mm | 2 mm  | 100 mm $\times$ 35 Times | 55 mm           |

HRRS Series  
NAK80 (40HRC)  
Milling Video



HRRS Series  
DH31S (52HRC)  
Milling Video

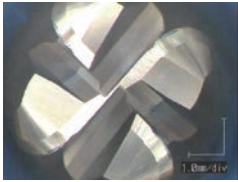
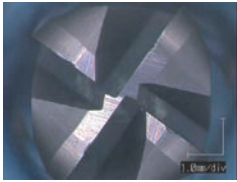
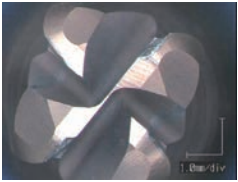
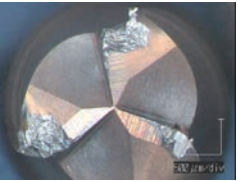
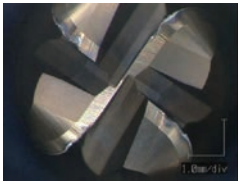

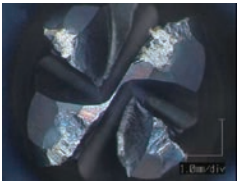
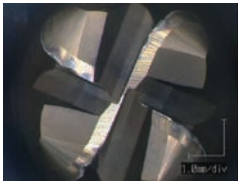
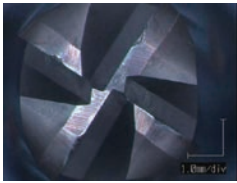
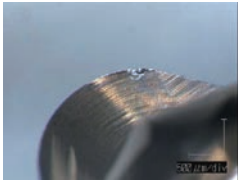
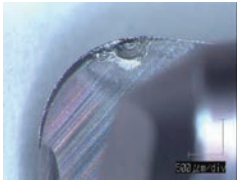



HRRS Series  
DH31 (52HRC)  
Milling Video



- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Pocket Milling Example: Milling with HRRS  $\phi 6 \times \text{CR1.5}$  SKD11 (60HRC)

|               | HRRS   | Competitor A: 4 Flutes   | Competitor B: 4 Flutes   | Competitor B: 3 Flutes   |
|---------------|--|--|--|--|
| Depth 0.9 mm  |   |   |   |  |
| Depth 12.3 mm |   |   |   | Broken   |
| Depth 16.5 mm |   |   | Broken   |  |
|               |  |  | <br>Pocket Milling<br>Cycle Time: 40 min |  |

| Spindle Speed           | Z helical Approach | Feed Rate    | $a_p$          | $a_e$          | Overhang Length | Cycle Time | Coolant           |
|-------------------------|--------------------|--------------|----------------|----------------|-----------------|------------|-------------------|
| 2,700 $\text{min}^{-1}$ | 1,350 mm/min       | 2,000 mm/min | 0.3 mm (0.05D) | 1.5 mm (0.25D) | 20 mm           | 40 min     | Air Blow (Nozzle) |

Longer tool life on 60HRC milling.

4 Flutes

$\phi 3\text{mm}$  Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



Size  $\phi 2 \sim \phi 12$

Short Shank Series

# HRRS-S



$\phi 2 \sim \phi 6$     $\phi 8 \sim \phi 12$

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

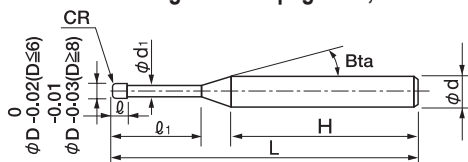
| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 | ●                                | ●               | ●      | ●      | ○      |        | ○         |                 |          |        |          |                       |                 |                       |                  |                                       |

## Features

Shorter overall length and overhang offer higher feed and precision.

Achieves larger step over by seamless corner radius design.

Rated to 65HRC milling. Refer to page 384, 385 for milling conditions.



The shank taper angle and the shank length (H) shown are not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 26 models

Unit (mm)

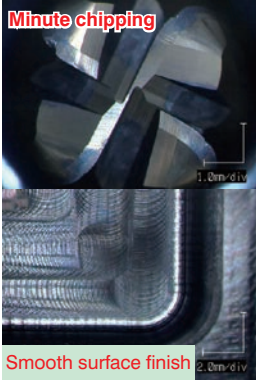
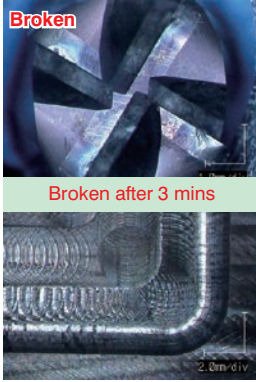
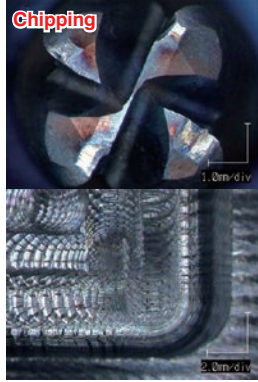
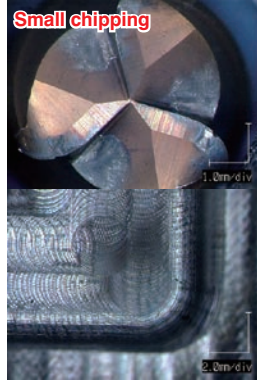
| Model Number       | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Shank Length H | Suggested Retail Price ¥ |
|--------------------|---------------------------|------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|----------------|--------------------------|
| HRRS 4020-03-06S   | 2                         | R0.3             | 6                      | 2                 | 1.91                     | 16°                   | 45               | 4                       | 33.0           | 9,450                    |
| HRRS 4020-05-06S   |                           | R0.5             |                        |                   |                          |                       | 45               |                         |                |                          |
| HRRS 4030-08-09-3S | 3                         | R0.8             | 9                      | 3                 | 2.92                     | 16°                   | 50               | 3                       | 38.5           | 8,820                    |
| HRRS 4030-08-09S   |                           |                  |                        |                   |                          |                       | 50               |                         |                |                          |
| HRRS 4040-05-12S   | 4                         | R0.5             | 12                     | 4                 | 3.82                     | 16°                   | 50               | 4                       | 35.0           | 9,000                    |
| HRRS 4040-05-12-6S |                           |                  |                        |                   |                          |                       | 50               |                         |                |                          |
| HRRS 4040-10-12S   |                           | R1               |                        |                   |                          |                       | 50               | 4                       | 35.0           | 9,000                    |
| HRRS 4040-10-12-6S |                           |                  |                        |                   |                          |                       | 50               |                         |                |                          |
| HRRS 4050-12-15S   | 5                         | R1.2             | 15                     | 5                 | 4.82                     | 16°                   | 50               | 6                       | 30.0           | 10,800                   |
| HRRS 4060-05-18S   | 6                         | R0.5             | 18                     | 6                 | 5.82                     | —                     | 50               | 6                       | 29.0           | 12,060                   |
| HRRS 4060-10-18S   |                           | R1               |                        |                   |                          |                       | 50               |                         |                |                          |
| HRRS 4060-15-18S   |                           | R1.5             |                        |                   |                          |                       | 50               | 6                       | 29.0           | 12,060                   |
| HRRS 4060-20-18S   |                           | R2               |                        |                   |                          |                       | 50               |                         |                |                          |
| HRRS 4080-05-24S   | 8                         | R0.5             | 24                     | 8                 | 7.82                     | —                     | 60               | 8                       | 33.0           | 15,030                   |
| HRRS 4080-10-24S   |                           | R1               |                        |                   |                          |                       | 60               |                         |                |                          |
| HRRS 4080-20-24S   |                           | R2               |                        |                   |                          |                       | 60               | 8                       | 33.0           | 15,030                   |
| HRRS 4080-30-24S   |                           | R3               |                        |                   |                          |                       | 60               |                         |                |                          |
| HRRS 4100-03-30S   | 10                        | R0.3             | 30                     | 10                | 9.82                     | —                     | 65               | 10                      | 31.5           | 19,800                   |
| HRRS 4100-05-30S   |                           | R0.5             |                        |                   |                          |                       | 65               |                         |                |                          |
| HRRS 4100-10-30S   |                           | R1               |                        |                   |                          |                       | 65               | 10                      | 31.5           | 19,800                   |
| HRRS 4100-20-30S   |                           | R2               |                        |                   |                          |                       | 65               |                         |                |                          |
| HRRS 4100-30-30S   | R3                        | 65               | 10                     | 31.5              | 19,800                   |                       |                  |                         |                |                          |
| HRRS 4120-05-36S   | 12                        | R0.5             | 36                     | 12                | 11.82                    | —                     | 75               | 12                      | 35.5           | 24,930                   |
| HRRS 4120-10-36S   |                           | R1               |                        |                   |                          |                       | 75               |                         |                |                          |
| HRRS 4120-20-36S   |                           | R2               |                        |                   |                          |                       | 75               | 12                      | 35.5           | 24,930                   |
| HRRS 4120-40-36S   |                           | R4               |                        |                   |                          |                       | 75               |                         |                |                          |



# Pocket Milling Example: Milling with HRRS $\phi 6 \times CR1.5$

NAK80 (40HRC)

4 Flutes

| HRRS   | Competitor A: 4 Flutes  | Competitor B: 4 Flutes  | Competitor B: 3 Flutes   |
|--|---|---|--|
|  |  |  |  |
| CR1.5, FL6 mm, EFL18 mm  | CR1.5, FL6 mm, EFL18 mm   | CR1.5, FL12 mm  | CR1.5, FL12 mm   |

| Spindle Speed           | Feed Rate     | $a_p$          | $a_e$       | Overhang Length | Cycle Time | Pocket Size            |
|-------------------------|---------------|----------------|-------------|-----------------|------------|------------------------|
| 9,000 min <sup>-1</sup> | 11,000 mm/min | 0.3 mm (0.05D) | 3 mm (0.5D) | 20 mm           | 20 min     | 40 × 180 × Depth 15 mm |

**Excellent chipping resistance and surface quality !**

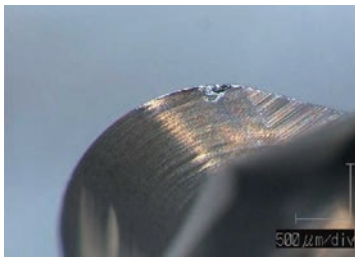
**Original corner radius design offers high rigidity and reduces cutting resistance.**

After milling SKD11 (60HRC)

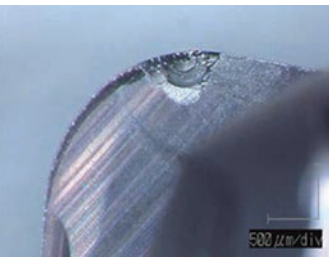
**HRRS**

**Competitor**

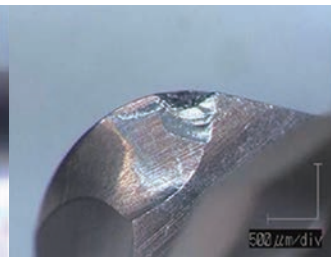
**Competitor**



Seamless corner radius with equal rake angle design. Reduces the cutting resistance and offers excellent chip evacuation to protect from the tool damage.



Flat and non-helix gash design. Badly damaged at tip point where cutting chips are trapped by poor chip evacuation.



Flat and helical gash design. Huge tool damage at tangent point where the gash shape abruptly changed and cutting chips could not evacuate properly.

| Spindle Speed           | Feed Rate    | $a_p$  | $a_e$  | Overhang Length | Pocket Size      |
|-------------------------|--------------|--------|--------|-----------------|------------------|
| 2,700 min <sup>-1</sup> | 2,000 mm/min | 0.3 mm | 1.5 mm | 20 mm           | 40 × 40 × 0.3 mm |

**Longer tool life with variable pitch design. Recommended for various coolant.**

- $\phi 3$ mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Long Neck Square
- Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball / Long Shank Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
  - Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Size  $\phi 2 \sim \phi 12$

# CRRS



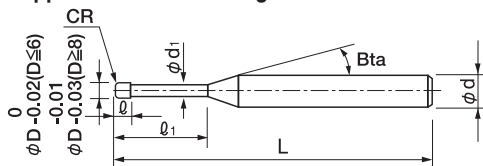
$\phi 2 \sim \phi 6$      $\phi 8 \sim \phi 12$

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        | ○         | ○               |          | ●      |          |                       | ●               | ●                     |                  |                                       |

## Features

Broad application range from Copper and Raw Materials to Hardened Steels (55HRC). UTCOAT offers long tool life. Variable pitch, high helix and positive rake angle offer stable milling. Reduced cutting resistance when using a helical approach or inclined angles.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 24 models

Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |   |    |   |        |
|-------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|---|----|---|--------|
| CRRS 4020-05-06   | 2                         | RO.5             | 6                         | 2                    | 1.91                     | 16°                   | 70               | 4                       | 10,500                   |   |    |   |        |
| CRRS 4030-08-09   | 3                         | RO.8             | 9                         | 3                    | 2.92                     | 16°                   | 70               | 6                       | 10,800                   |   |    |   |        |
| CRRS 4040-03-12   | 4                         | RO.3             | 12                        | 4                    | 3.82                     | 16°                   | 60               | 6                       | 11,600                   |   |    |   |        |
| CRRS 4040-05-12-4 |                           | RO.5             |                           |                      |                          | —                     | 70               | 4                       | 10,000                   |   |    |   |        |
| CRRS 4040-05-12   |                           | R1               |                           |                      |                          | 16°                   | 60               | 6                       | 11,600                   |   |    |   |        |
| CRRS 4040-10-12-4 |                           |                  |                           |                      |                          | —                     | 70               | 4                       | 10,000                   |   |    |   |        |
| CRRS 4040-10-12   | 5                         | R1               | 15                        | 5                    | 4.82                     | 16°                   | 70               | 6                       | 11,600                   |   |    |   |        |
| CRRS 4050-12-15   |                           |                  |                           |                      |                          | 16°                   | 70               | 6                       | 12,000                   |   |    |   |        |
| CRRS 4060-03-18   |                           |                  |                           |                      |                          | RO.3                  | 18               | 6                       | 5.82                     | — | 90 | 6 | 13,400 |
| CRRS 4060-05-18   |                           |                  |                           |                      |                          | RO.5                  |                  |                         |                          |   | 60 | 6 | 13,400 |
| CRRS 4060-10-18   | R1                        | 60               | 6                         | 13,400               |                          |                       |                  |                         |                          |   |    |   |        |
| CRRS 4060-15-18   | R1.5                      | 24               | 24                        | 8                    | 7.82                     | —                     | 90               | 6                       | 13,400                   |   |    |   |        |
| CRRS 4080-03-24   | RO.3                      |                  |                           |                      |                          |                       | 100              | 8                       | 16,700                   |   |    |   |        |
| CRRS 4080-05-26   | RO.5                      |                  |                           |                      |                          |                       | 70               | 8                       | 16,700                   |   |    |   |        |
| CRRS 4080-10-26   | R1                        |                  |                           |                      |                          |                       | 70               | 8                       | 16,700                   |   |    |   |        |
| CRRS 4080-20-24   | R2                        | 100              | 8                         | 16,700               |                          |                       |                  |                         |                          |   |    |   |        |
| CRRS 4100-03-30   | 10                        | RO.3             | 30                        | 10                   | 9.82                     | —                     | 110              | 10                      | 22,000                   |   |    |   |        |
| CRRS 4100-05-30   |                           | RO.5             |                           |                      |                          |                       | 80               | 10                      | 22,000                   |   |    |   |        |
| CRRS 4100-10-30   |                           | R1               |                           |                      |                          |                       | 80               | 10                      | 22,000                   |   |    |   |        |
| CRRS 4100-20-30   |                           | R2               |                           |                      |                          |                       | 110              | 10                      | 22,000                   |   |    |   |        |
| CRRS 4120-03-36   | 12                        | RO.3             | 36                        | 12                   | 11.82                    | —                     | 120              | 12                      | 27,700                   |   |    |   |        |
| CRRS 4120-05-36   |                           | RO.5             |                           |                      |                          |                       | 120              | 12                      | 27,700                   |   |    |   |        |
| CRRS 4120-10-36   |                           | R1               |                           |                      |                          |                       | 120              | 12                      | 27,700                   |   |    |   |        |
| CRRS 4120-20-36   |                           | R2               |                           |                      |                          |                       | 120              | 12                      | 27,700                   |   |    |   |        |

# Milling Conditions for CRRS

## ◆ Roughing

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S55C<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM / SUS(225~325HB)<br>*Use cutting oils for Stainless Steels. |                    |                                 |                                  | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / HPM / SKD / SKT / STAVAX(30~55HRC)<br>*Recommend oil mist. |                    |                                 |                                  |
|---------------|-----------------------|--------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4020-05-06    | 2                     | R0.5               | 30,000                                   | 7,200              | 0.08                            | 0.8                              | 30,000   | 7,200              | 0.04                            | 0.66                             | 24,000  | 7,000              | 0.02                            | 0.59                             |
| 4030-08-09    | 3                     | R0.8               | 20,000                                   | 8,400              | 0.09                            | 1.2                              | 20,000   | 7,200              | 0.04                            | 1.08                             | 16,000  | 7,000              | 0.04                            | 0.88                             |
| 4040-03-12    | 4                     | R0.3               | 15,000                                   | 9,600              | 0.09                            | 1.6                              | 15,000   | 7,200              | 0.05                            | 1.32                             | 12,000  | 7,000              | 0.05                            | 1.17                             |
| 4040-05-12-4  |                       | R0.5               | 15,000                                   | 9,600              | 0.1                             | 1.6                              | 15,000   | 7,200              | 0.05                            | 1.35                             | 12,000  | 7,000              | 0.05                            | 1.26                             |
| 4040-05-12    |                       |                    | 15,000                                   | 9,600              | 0.1                             | 1.6                              | 15,000   | 7,200              | 0.05                            | 1.35                             | 12,000  | 7,000              | 0.05                            | 1.26                             |
| 4040-10-12-4  |                       | R1                 | 15,000                                   | 9,600              | 0.11                            | 1.6                              | 15,000   | 7,200              | 0.05                            | 1.53                             | 12,000  | 7,000              | 0.06                            | 1.33                             |
| 4040-10-12    |                       |                    | 15,000                                   | 9,600              | 0.11                            | 1.6                              | 15,000   | 7,200              | 0.05                            | 1.53                             | 12,000  | 7,000              | 0.06                            | 1.33                             |
| 4050-12-15    | 5                     | R1.2               | 12,000                                   | 10,800             | 0.13                            | 2                                | 12,000   | 7,200              | 0.06                            | 1.8                              | 9,600   | 6,300              | 0.06                            | 1.54                             |
| 4060-03-18    | 6                     | R0.3               | 10,000                                   | 12,000             | 0.13                            | 2.4                              | 10,000   | 7,200              | 0.07                            | 1.94                             | 8,000   | 5,250              | 0.07                            | 1.63                             |
| 4060-05-18    |                       | R0.5               | 10,000                                   | 12,000             | 0.14                            | 2.4                              | 10,000   | 7,200              | 0.07                            | 1.98                             | 8,000   | 5,250              | 0.07                            | 1.75                             |
| 4060-10-18    |                       | R1                 | 10,000                                   | 12,000             | 0.15                            | 2.4                              | 10,000   | 7,200              | 0.07                            | 2.16                             | 8,000   | 5,250              | 0.08                            | 1.75                             |
| 4060-15-18    |                       | R1.5               | 10,000                                   | 12,000             | 0.17                            | 2.4                              | 10,000   | 7,200              | 0.08                            | 2.34                             | 8,000   | 5,250              | 0.11                            | 1.75                             |
| 4080-03-24    |                       | R0.3               | 7,500                                    | 12,000             | 0.17                            | 2.86                             | 7,500  | 7,200              | 0.08                            | 2.76                             | 6,000   | 4,100              | 0.15                            | 1.77                             |
| 4080-05-26    | 8                     | R0.5               | 7,500                                    | 12,000             | 0.18                            | 2.64                             | 7,500  | 7,200              | 0.08                            | 2.61                             | 6,000   | 4,100              | 0.14                            | 1.76                             |
| 4080-10-26    |                       | R1                 | 7,500                                    | 12,000             | 0.18                            | 2.72                             | 7,500  | 7,200              | 0.09                            | 2.7                              | 6,000   | 4,100              | 0.16                            | 1.76                             |
| 4080-20-24    |                       | R2                 | 7,500                                    | 12,000             | 0.22                            | 2.88                             | 7,500  | 7,200              | 0.1                             | 2.79                             | 6,000   | 4,100              | 0.18                            | 1.96                             |
| 4100-03-30    | 10                    | R0.3               | 6,000                                    | 12,000             | 0.2                             | 3.04                             | 5,000  | 5,400              | 0.14                            | 2.82                             | 4,800   | 4,100              | 0.18                            | 1.89                             |
| 4100-05-30    |                       | R0.5               | 6,000                                    | 12,000             | 0.22                            | 3.04                             | 5,000  | 5,400              | 0.14                            | 2.88                             | 4,800   | 4,100              | 0.18                            | 2.03                             |
| 4100-10-30    |                       | R1                 | 6,000                                    | 12,000             | 0.24                            | 3.28                             | 5,000  | 5,400              | 0.14                            | 2.97                             | 4,800   | 4,100              | 0.19                            | 2.1                              |
| 4100-20-30    |                       | R2                 | 6,000                                    | 12,000             | 0.26                            | 3.44                             | 5,000  | 5,400              | 0.14                            | 3.06                             | 4,800   | 4,100              | 0.2                             | 2.45                             |
| 4120-03-36    |                       | 12                 | R0.3                                     | 5,000              | 12,000                          | 0.21                             | 3.32   | 3,000              | 4,320                           | 0.18                             | 2.9   | 4,000              | 4,100                           | 0.19                             |
| 4120-05-36    | R0.5                  |                    | 5,000                                    | 12,000             | 0.24                            | 3.32                             | 3,000  | 4,320              | 0.18                            | 2.96                             | 4,000   | 4,100              | 0.19                            | 2.32                             |
| 4120-10-36    | R1                    |                    | 5,000                                    | 12,000             | 0.26                            | 3.59                             | 3,000  | 4,320              | 0.18                            | 3.06                             | 4,000   | 4,100              | 0.2                             | 2.4                              |
| 4120-20-36    | R2                    |                    | 5,000                                    | 12,000             | 0.28                            | 3.76                             | 3,000  | 4,320              | 0.18                            | 3.15                             | 4,000   | 4,100              | 0.21                            | 2.8                              |

| WORK MATERIAL |                       |                    | TITANIUM / TITANIUM ALLOYS<br>Ti-6Al-4V |                    |                                 |                                  | HEAT RESISTANT ALLOYS<br>Inconel718 |                    |                                 |                                  |
|---------------|-----------------------|--------------------|---|--------------------|---------------------------------|----------------------------------|-------------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Spindle Speed (min <sup>-1</sup> )      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4020-05-06    | 2                     | R0.5               | 21,420                                  | 4,010              | 0.03                            | 0.33                             | 5,140                               | 810                | 0.03                            | 0.33                             |
| 4030-08-09    | 3                     | R0.8               | 14,280                                  | 4,010              | 0.03                            | 0.54                             | 3,430                               | 810                | 0.03                            | 0.54                             |
| 4040-03-12    | 4                     | R0.3               | 10,710                                  | 4,010              | 0.04                            | 0.66                             | 2,570                               | 810                | 0.04                            | 0.66                             |
| 4040-05-12-4  |                       | R0.5               | 10,710                                  | 4,010              | 0.04                            | 0.68                             | 2,570                               | 810                | 0.04                            | 0.68                             |
| 4040-05-12    |                       |                    | 10,710                                  | 4,010              | 0.04                            | 0.68                             | 2,570                               | 810                | 0.04                            | 0.68                             |
| 4040-10-12-4  |                       | R1                 | 10,710                                  | 4,010              | 0.04                            | 0.77                             | 2,570                               | 810                | 0.04                            | 0.77                             |
| 4040-10-12    |                       |                    | 10,710                                  | 4,010              | 0.04                            | 0.77                             | 2,570                               | 810                | 0.04                            | 0.77                             |
| 4050-12-15    | 5                     | R1.2               | 8,570                                   | 4,010              | 0.04                            | 0.9                              | 2,060                               | 810                | 0.04                            | 0.9                              |
| 4060-03-18    | 6                     | R0.3               | 7,140                                   | 4,010              | 0.05                            | 1                                | 1,740                               | 810                | 0.05                            | 1                                |
| 4060-05-18    |                       | R0.5               | 7,140                                   | 4,010              | 0.05                            | 1                                | 1,740                               | 810                | 0.05                            | 1                                |
| 4060-10-18    |                       | R1                 | 7,140                                   | 4,010              | 0.05                            | 1.08                             | 1,740                               | 810                | 0.05                            | 1.08                             |
| 4060-15-18    |                       | R1.5               | 7,140                                   | 4,010              | 0.05                            | 1.08                             | 1,740                               | 810                | 0.05                            | 1.08                             |
| 4080-03-24    |                       | R0.3               | 5,360                                   | 4,000              | 0.05                            | 1.28                             | 1,580                               | 800                | 0.05                            | 1.28                             |
| 4080-05-26    | 8                     | R0.5               | 5,360                                   | 4,000              | 0.05                            | 1.31                             | 1,580                               | 800                | 0.05                            | 1.31                             |
| 4080-10-26    |                       | R1                 | 5,360                                   | 4,000              | 0.05                            | 1.35                             | 1,580                               | 800                | 0.05                            | 1.35                             |
| 4080-20-24    |                       | R2                 | 5,360                                   | 4,000              | 0.05                            | 1.4                              | 1,580                               | 800                | 0.05                            | 1.4                              |
| 4100-03-30    | 10                    | R0.3               | 3,570                                   | 3,010              | 0.09                            | 1.41                             | 1,050                               | 550                | 0.09                            | 1.41                             |
| 4100-05-30    |                       | R0.5               | 3,570                                   | 3,010              | 0.09                            | 1.44                             | 1,050                               | 550                | 0.09                            | 1.44                             |
| 4100-10-30    |                       | R1                 | 3,570                                   | 3,010              | 0.09                            | 1.49                             | 1,050                               | 550                | 0.09                            | 1.49                             |
| 4100-20-30    |                       | R2                 | 3,570                                   | 3,010              | 0.09                            | 1.53                             | 1,050                               | 550                | 0.09                            | 1.53                             |
| 4120-03-36    |                       | 12                 | R0.3                                    | 2,140              | 2,400                           | 0.12                             | 1.45                                | 640                | 410                             | 0.12                             |
| 4120-05-36    | R0.5                  |                    | 2,140                                   | 2,400              | 0.12                            | 1.48                             | 640                                 | 410                | 0.12                            | 1.48                             |
| 4120-10-36    | R1                    |                    | 2,140                                   | 2,400              | 0.12                            | 1.53                             | 640                                 | 410                | 0.12                            | 1.53                             |
| 4120-20-36    | R2                    |                    | 2,140                                   | 2,400              | 0.12                            | 1.58                             | 640                                 | 410                | 0.12                            | 1.58                             |

4 Flutes

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for CRRS

◆Finishing (Flat / Inclined surface)

| WORK MATERIAL |                       |                    | CARBON STEELS<br>S45C / S55C<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM / SUS(225~325HB)<br>*Use cutting oils for Stainless Steels. |                    |                                 |                                  | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / HPM / SKD / SKT / STAVAX(30~55HRC)<br>*Recommend oil mist. |                    |                                 |                                  |
|---------------|-----------------------|--------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4020-05-06    | 2                     | R0.5               | 30,000                                   | 1,720              | 0.1                             | 0.06                             | 30,000   | 1,510              | 0.05                            | 0.05                             | 24,000  | 1,070              | 0.05                            | 0.04                             |
| 4030-08-09    | 3                     | R0.8               | 20,000                                   | 1,890              | 0.1                             | 0.09                             | 20,000   | 1,660              | 0.05                            | 0.08                             | 16,000  | 1,160              | 0.05                            | 0.07                             |
| 4040-03-12    | 4                     | R0.3               | 15,000                                   | 1,050              | 0.1                             | 0.07                             | 15,000   | 910                | 0.05                            | 0.06                             | 12,000  | 620                | 0.05                            | 0.05                             |
| 4040-05-12-4  |                       | R0.5               | 15,000                                   | 1,360              | 0.1                             | 0.09                             | 15,000   | 1,180              | 0.05                            | 0.08                             | 12,000  | 810                | 0.05                            | 0.07                             |
| 4040-05-12    |                       | R1                 | 15,000                                   | 1,360              | 0.1                             | 0.09                             | 15,000   | 1,180              | 0.05                            | 0.08                             | 12,000  | 810                | 0.05                            | 0.07                             |
| 4040-10-12-4  |                       |                    | 15,000                                   | 1,920              | 0.1                             | 0.13                             | 15,000   | 1,670              | 0.05                            | 0.11                             | 12,000  | 1,150              | 0.05                            | 0.1                              |
| 4040-10-12    |                       |                    | 15,000                                   | 1,920              | 0.1                             | 0.13                             | 15,000   | 1,670              | 0.05                            | 0.11                             | 12,000  | 1,150              | 0.05                            | 0.1                              |
| 4050-12-15    | 5                     | R1.2               | 12,000                                   | 1,910              | 0.1                             | 0.16                             | 12,000   | 1,630              | 0.05                            | 0.14                             | 9,600   | 1,120              | 0.05                            | 0.12                             |
| 4060-03-18    | 6                     | R0.3               | 10,000                                   | 890                | 0.2                             | 0.09                             | 10,000   | 760                | 0.1                             | 0.08                             | 8,000   | 510                | 0.1                             | 0.06                             |
| 4060-05-18    |                       | R0.5               | 10,000                                   | 1,150              | 0.2                             | 0.12                             | 10,000   | 990                | 0.1                             | 0.1                              | 8,000   | 670                | 0.1                             | 0.08                             |
| 4060-10-18    |                       | R1                 | 10,000                                   | 1,630              | 0.2                             | 0.16                             | 10,000   | 1,400              | 0.1                             | 0.14                             | 8,000   | 950                | 0.1                             | 0.12                             |
| 4060-15-18    |                       | R1.5               | 10,000                                   | 2,000              | 0.2                             | 0.2                              | 10,000   | 1,720              | 0.1                             | 0.17                             | 8,000   | 1,170              | 0.1                             | 0.15                             |
| 4080-03-24    |                       | R0.3               | 7,500                                    | 1,170              | 0.2                             | 0.11                             | 7,500  | 1,050              | 0.1                             | 0.09                             | 6,000   | 720                | 0.1                             | 0.08                             |
| 4080-05-26    | 8                     | R0.5               | 7,500                                    | 990                | 0.2                             | 0.13                             | 7,500  | 860                | 0.1                             | 0.11                             | 6,000   | 580                | 0.1                             | 0.1                              |
| 4080-10-26    |                       | R1                 | 7,500                                    | 1,410              | 0.2                             | 0.19                             | 7,500  | 1,210              | 0.1                             | 0.16                             | 6,000   | 830                | 0.1                             | 0.14                             |
| 4080-20-24    |                       | R2                 | 7,500                                    | 1,990              | 0.2                             | 0.27                             | 7,500  | 1,720              | 0.1                             | 0.23                             | 6,000   | 1,170              | 0.1                             | 0.2                              |
| 4100-03-30    | 10                    | R0.3               | 6,000                                    | 720                | 0.2                             | 0.12                             | 5,000  | 510                | 0.1                             | 0.1                              | 4,800   | 400                | 0.1                             | 0.08                             |
| 4100-05-30    |                       | R0.5               | 6,000                                    | 940                | 0.2                             | 0.16                             | 5,000  | 660                | 0.1                             | 0.13                             | 4,800   | 520                | 0.1                             | 0.11                             |
| 4100-10-30    |                       | R1                 | 6,000                                    | 1,330              | 0.2                             | 0.22                             | 5,000  | 940                | 0.1                             | 0.19                             | 4,800   | 740                | 0.1                             | 0.15                             |
| 4100-20-30    |                       | R2                 | 6,000                                    | 1,890              | 0.2                             | 0.32                             | 5,000  | 1,340              | 0.1                             | 0.27                             | 4,800   | 1,050              | 0.1                             | 0.22                             |
| 4120-03-36    |                       | 12                 | R0.3                                     | 5,000              | 680                             | 0.2                              | 0.14   | 3,000              | 330                             | 0.1                              | 0.1   | 4,000              | 360                             | 0.1                              |
| 4120-05-36    | R0.5                  |                    | 5,000                                    | 880                | 0.2                             | 0.18                             | 3,000  | 430                | 0.1                             | 0.14                             | 4,000   | 480                | 0.1                             | 0.12                             |
| 4120-10-36    | R1                    |                    | 5,000                                    | 1,240              | 0.2                             | 0.24                             | 3,000  | 610                | 0.1                             | 0.2                              | 4,000   | 680                | 0.1                             | 0.16                             |
| 4120-20-36    | R2                    |                    | 5,000                                    | 1,760              | 0.2                             | 0.35                             | 3,000  | 870                | 0.1                             | 0.29                             | 4,000   | 960                | 0.1                             | 0.24                             |

| WORK MATERIAL |                       |                    | TITANIUM / TITANIUM ALLOYS<br>Ti-6Al-4V |                    |                                 |                                  | HEAT RESISTANT ALLOYS<br>Inconel718 |                    |                                 |                                  |
|---------------|-----------------------|--------------------|---|--------------------|---------------------------------|----------------------------------|-------------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Spindle Speed (min <sup>-1</sup> )      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4020-05-06    | 2                     | R0.5               | 21,420                                  | 840                | 0.04                            | 0.03                             | 5,140                               | 170                | 0.04                            | 0.03                             |
| 4030-08-09    | 3                     | R0.8               | 14,280                                  | 920                | 0.04                            | 0.04                             | 3,430                               | 190                | 0.04                            | 0.04                             |
| 4040-03-12    | 4                     | R0.3               | 10,710                                  | 510                | 0.04                            | 0.03                             | 2,570                               | 100                | 0.04                            | 0.03                             |
| 4040-05-12-4  |                       | R0.5               | 10,710                                  | 660                | 0.04                            | 0.04                             | 2,570                               | 130                | 0.04                            | 0.04                             |
| 4040-05-12    |                       |                    | 10,710                                  | 660                | 0.04                            | 0.04                             | 2,570                               | 130                | 0.04                            | 0.04                             |
| 4040-10-12-4  |                       |                    | R1                                      | 10,710             | 930                             | 0.04                             | 0.06                                | 2,570              | 190                             | 0.04                             |
| 4040-10-12    |                       | 10,710             |   | 930                | 0.04                            | 0.06                             | 2,570                               | 190                | 0.04                            | 0.06                             |
| 4050-12-15    | 5                     | R1.2               | 8,570                                   | 910                | 0.03                            | 0.07                             | 2,060                               | 180                | 0.03                            | 0.07                             |
| 4060-03-18    | 6                     | R0.3               | 7,140                                   | 420                | 0.07                            | 0.04                             | 1,740                               | 90                 | 0.07                            | 0.04                             |
| 4060-05-18    |                       | R0.5               | 7,140                                   | 550                | 0.07                            | 0.05                             | 1,740                               | 110                | 0.07                            | 0.05                             |
| 4060-10-18    |                       | R1                 | 7,140                                   | 780                | 0.07                            | 0.07                             | 1,740                               | 160                | 0.07                            | 0.07                             |
| 4060-15-18    |                       | R1.5               | 7,140                                   | 960                | 0.06                            | 0.08                             | 1,740                               | 190                | 0.06                            | 0.08                             |
| 4080-03-24    |                       | R0.3               | 5,360                                   | 400                | 0.06                            | 0.04                             | 1,580                               | 80                 | 0.06                            | 0.04                             |
| 4080-05-26    | 8                     | R0.5               | 5,360                                   | 480                | 0.06                            | 0.06                             | 1,580                               | 100                | 0.06                            | 0.06                             |
| 4080-10-26    |                       | R1                 | 5,360                                   | 670                | 0.06                            | 0.08                             | 1,580                               | 130                | 0.06                            | 0.08                             |
| 4080-20-24    |                       | R2                 | 5,360                                   | 960                | 0.05                            | 0.12                             | 1,580                               | 190                | 0.05                            | 0.12                             |
| 4100-03-30    | 10                    | R0.3               | 3,570                                   | 280                | 0.06                            | 0.05                             | 1,050                               | 50                 | 0.06                            | 0.05                             |
| 4100-05-30    |                       | R0.5               | 3,570                                   | 370                | 0.06                            | 0.07                             | 1,050                               | 70                 | 0.06                            | 0.07                             |
| 4100-10-30    |                       | R1                 | 3,570                                   | 520                | 0.06                            | 0.1                              | 1,050                               | 100                | 0.06                            | 0.1                              |
| 4100-20-30    |                       | R2                 | 3,570                                   | 750                | 0.06                            | 0.14                             | 1,050                               | 140                | 0.06                            | 0.14                             |
| 4120-03-36    |                       | 12                 | R0.3                                    | 2,140              | 240                             | 0.07                             | 0.05                                | 640                | 40                              | 0.07                             |
| 4120-05-36    | R0.5                  |                    | 2,140                                   | 310                | 0.07                            | 0.07                             | 640                                 | 50                 | 0.07                            | 0.07                             |
| 4120-10-36    | R1                    |                    | 2,140                                   | 400                | 0.07                            | 0.11                             | 640                                 | 70                 | 0.07                            | 0.12                             |
| 4120-20-36    | R2                    |                    | 2,140                                   | 520                | 0.07                            | 0.17                             | 640                                 | 100                | 0.07                            | 0.17                             |

## Milling Conditions for CRRS

Please adjust milling parameter referring following table.

D : Outside Diameter (mm)

L : Overhang Length (mm)

D :  $\phi 2.0 \sim 3.0$

| Overhang Length<br>L/D | Spindle Speed<br>(min <sup>-1</sup> ) | Feed Rate<br>(mm/min) | $a_p$<br>Axial Depth<br>(mm) | $a_e$<br>Radial Depth<br>(mm) |
|------------------------|---------------------------------------|-----------------------|------------------------------|-------------------------------|
| L/D ≤ 6                | × 1                                   | × 1                   | × 1                          | × 1                           |
| L/D = 7                | × 0.8                                 | × 0.8                 | × 0.8                        | × 0.9                         |
| L/D = 8                | × 0.7                                 | × 0.7                 | × 0.7                        | × 0.9                         |
| L/D = 9                | × 0.7                                 | × 0.7                 | × 0.6                        | × 0.8                         |
| L/D = 10               | × 0.6                                 | × 0.6                 | × 0.6                        | × 0.7                         |

D :  $\phi 4.0 \sim 6.0$

| Overhang Length<br>L/D | Spindle Speed<br>(min <sup>-1</sup> ) | Feed Rate<br>(mm/min) | $a_p$<br>Axial Depth<br>(mm) | $a_e$<br>Radial Depth<br>(mm) |
|------------------------|---------------------------------------|-----------------------|------------------------------|-------------------------------|
| L/D ≤ 4                | × 1                                   | × 1                   | × 1                          | × 1                           |
| L/D = 5                | × 0.9                                 | × 0.8                 | × 0.9                        | × 0.9                         |
| L/D = 6                | × 0.8                                 | × 0.7                 | × 0.8                        | × 0.9                         |
| L/D = 7                | × 0.7                                 | × 0.6                 | × 0.6                        | × 0.8                         |
| L/D = 8                | × 0.5                                 | × 0.4                 | × 0.6                        | × 0.7                         |

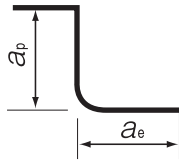
D :  $\phi 8.0 \sim 12.0$

| Overhang Length<br>L/D | Spindle Speed<br>(min <sup>-1</sup> ) | Feed Rate<br>(mm/min) | $a_p$<br>Axial Depth<br>(mm) | $a_e$<br>Radial Depth<br>(mm) |
|------------------------|---------------------------------------|-----------------------|------------------------------|-------------------------------|
| L/D ≤ 4                | × 1                                   | × 1                   | × 1                          | × 1                           |
| L/D = 5                | × 0.7                                 | × 0.6                 | × 0.6                        | × 0.8                         |
| L/D = 6                | × 0.5                                 | × 0.4                 | × 0.5                        | × 0.7                         |

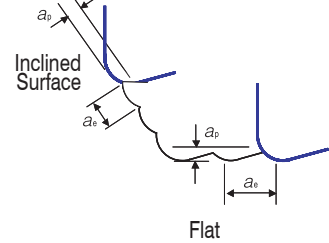
### Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Only adjust the spindle speed to calculate milling conditions based on the overhang length in finishing process.
- Every coolant offers stable milling.
- Recommend wet coolant for Stainless Steels.

Roughing Parameter



Finishing Parameter  
(Flat / Inclined Surface)



4 Flutes

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral  
V Cutter

Spiral  
V Cutter

Drill

Drill

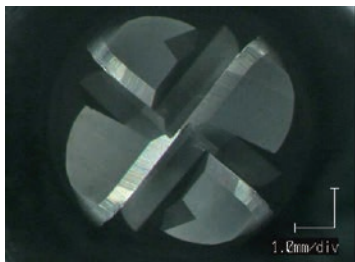
Technical Data

Technical Data

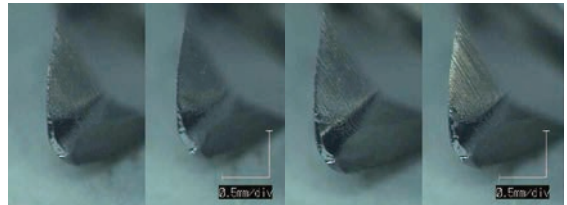
Tools After Milling by Different Work Materials CRRS  $\phi 6 \times CRO.5$

| Spindle Speed            | Feed Rate     | $a_p$   | $a_e$  | Overhang Length | Cycle Time | Coolant           |
|--------------------------|---------------|---------|--------|-----------------|------------|-------------------|
| 10,000 min <sup>-1</sup> | 12,000 mm/min | 0.14 mm | 2.4 mm | 24 mm           | 90 min     | Air Blow (Nozzle) |

S50C

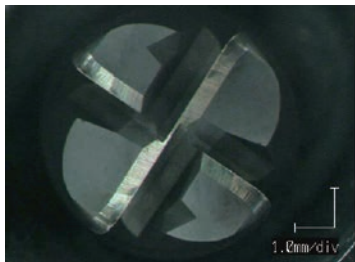


Relief Wear Width  
0.070 mm

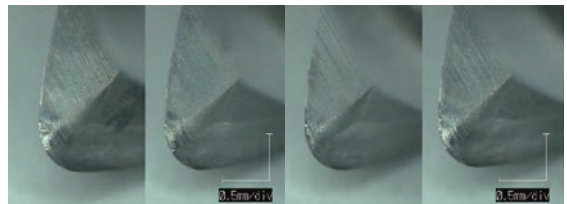


| Spindle Speed            | Feed Rate    | $a_p$   | $a_e$   | Overhang Length | Cycle Time | Coolant       |
|--------------------------|--------------|---------|---------|-----------------|------------|---------------|
| 10,000 min <sup>-1</sup> | 7,200 mm/min | 0.07 mm | 1.98 mm | 24 mm           | 84 min     | Water Soluble |

SUS304



Relief Wear Width  
0.032 mm

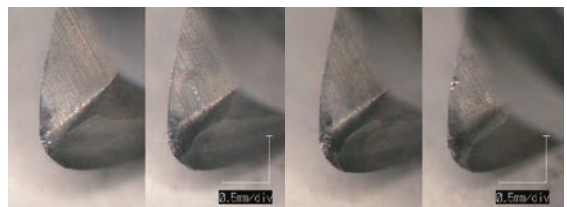


| Spindle Speed           | Feed Rate    | $a_p$   | $a_e$   | Overhang Length | Cycle Time | Coolant  |
|-------------------------|--------------|---------|---------|-----------------|------------|----------|
| 8,000 min <sup>-1</sup> | 5,250 mm/min | 0.07 mm | 1.75 mm | 24 mm           | 56 min     | Oil Mist |

STAVAX (52HRC)



Relief Wear Width  
0.087 mm



- $\phi 3$ mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



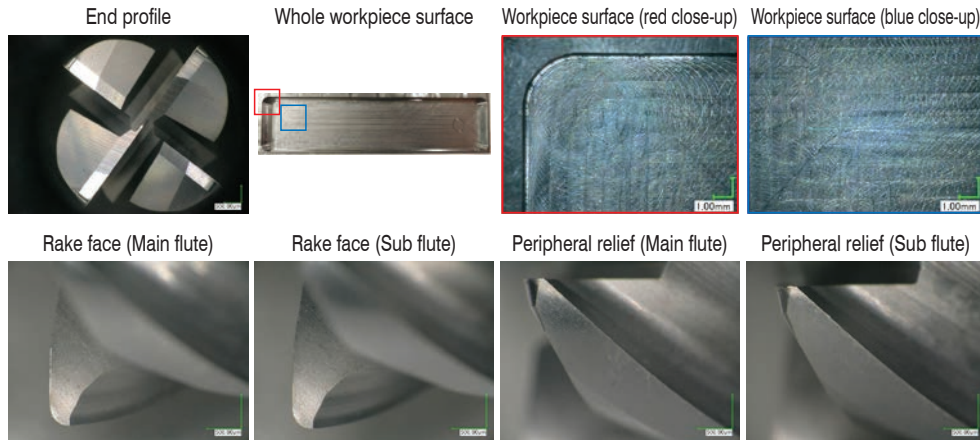
## CRRS $\phi 6 \times CR0.3$ Milling Example

Ti-6Al-4V

| Spindle Speed            | Feed Rate    | $a_p$   | $a_e$ | Cycle Time | Coolant                         |
|--------------------------|--------------|---------|-------|------------|---------------------------------|
| $7,150 \text{ min}^{-1}$ | 4,000 mm/min | 0.05 mm | 1 mm  | 67 min     | Water Soluble (Through-spindle) |

Square pocket size  $100 \times 25 \times 4 \text{ mm}$

No vibration and chattering. No burrs or chattering on workpiece. No tool damage and tool wear within normal range.



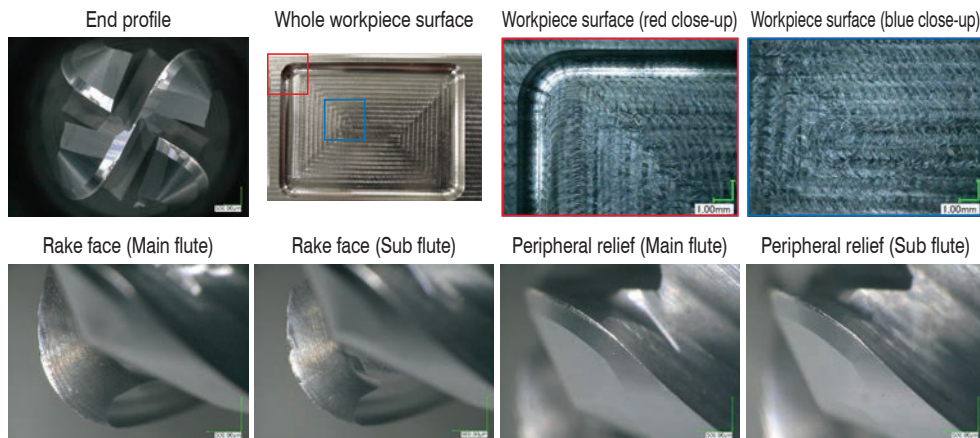
## CRRS $\phi 6 \times CR1.5$ Milling Example

Inconel718

| Spindle Speed            | Feed Rate  | $a_p$   | $a_e$  | Cycle Time | Coolant                         |
|--------------------------|------------|---------|--------|------------|---------------------------------|
| $1,740 \text{ min}^{-1}$ | 820 mm/min | 0.06 mm | 1.1 mm | 63 min     | Water Soluble (Through-spindle) |

Square pocket size  $40 \times 30 \times 3 \text{ mm}$

No vibration and chattering. No burrs or chattering on workpiece. Chipping on rake face due to wear on the bottom cutting edge. Acceptable given the 60min milling of Inconel.



4 Flutes

$\phi 3 \text{mm}$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 1 \sim \phi 6$

# DCLRS

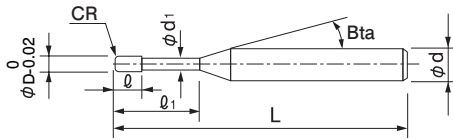


Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           | ○               | ★        | ○      | ○        | ●                     |                 |                       |                  | ○                                     |

## Features

**Diamond coated 4 Flute Long Neck Radius End Mills for Graphite Electrodes.**  
**Original diamond coating offers excellent resistance to wear on Graphite milling.**  
**Long life tool with optimized flute geometry and high adhesion diamond coating.**



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 39 models

Unit (mm)

| Model Number       | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------------|---------------------------|------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| DCLRS 4010-002-060 | 1                         | R0.02            | 6                      | 2                 | 0.97                     | 16°                   | 50               | 4                       | 16,000                   |
| DCLRS 4010-002-100 |                           |                  | 10                     |                   |                          |                       | 50               | 4                       | 16,000                   |
| DCLRS 4010-002-200 |                           |                  | 20                     |                   |                          |                       | 60               | 4                       | 16,000                   |
| DCLRS 4010-005-060 |                           | R0.05            | 6                      |                   |                          |                       | 50               | 4                       | 16,000                   |
| DCLRS 4010-005-100 |                           |                  | 10                     |                   |                          |                       | 50               | 4                       | 16,000                   |
| DCLRS 4010-005-200 |                           |                  | 20                     |                   |                          |                       | 60               | 4                       | 16,000                   |
| DCLRS 4015-002-120 | 1.5                       | R0.02            | 12                     | 3                 | 1.47                     | 16°                   | 55               | 4                       | 16,000                   |
| DCLRS 4015-002-200 |                           |                  | 20                     |                   |                          |                       | 60               | 4                       | 16,000                   |
| DCLRS 4015-002-300 |                           |                  | 30                     |                   |                          |                       | 80               | 4                       | 17,000                   |
| DCLRS 4015-005-120 |                           | R0.05            | 12                     |                   |                          |                       | 55               | 4                       | 16,000                   |
| DCLRS 4015-005-200 |                           |                  | 20                     |                   |                          |                       | 60               | 4                       | 16,000                   |
| DCLRS 4015-005-300 |                           |                  | 30                     |                   |                          |                       | 80               | 4                       | 17,000                   |



Unit (mm)

| Model Number       | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| DCLRS 4020-005-100 | 2                         | R0.05            | 10                        | 4                    | 1.98                     | 16°                   | 50               | 4                       | 16,000                   |
| DCLRS 4020-005-200 |                           |                  | 20                        |                      |                          |                       | 60               | 4                       | 16,000                   |
| DCLRS 4020-02-100  |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 16,000                   |
| DCLRS 4020-02-200  |                           | R0.2             | 20                        |                      |                          |                       | 60               | 4                       | 16,000                   |
| DCLRS 4020-02-300  |                           |                  | 30                        |                      |                          |                       | 80               | 4                       | 17,000                   |
| DCLRS 4020-05-100  |                           |                  | 10                        |                      |                          |                       | 50               | 4                       | 16,000                   |
| DCLRS 4020-05-200  |                           | R0.5             | 20                        |                      |                          |                       | 60               | 4                       | 16,000                   |
| DCLRS 4020-05-300  |                           |                  | 30                        |                      |                          |                       | 80               | 4                       | 17,000                   |
| DCLRS 4030-005-160 |                           |                  | 3                         |                      |                          |                       | R0.05            | 16                      | 6                        |
| DCLRS 4030-005-200 | 20                        | 60               |                           | 4                    | 18,000                   |                       |                  |                         |                          |
| DCLRS 4030-005-300 | 30                        | 80               |                           | 4                    | 20,000                   |                       |                  |                         |                          |
| DCLRS 4030-02-160  | R0.2                      | 16               |                           | 60                   | 4                        | 18,000                |                  |                         |                          |
| DCLRS 4030-02-200  |                           | 20               |                           | 60                   | 4                        | 18,000                |                  |                         |                          |
| DCLRS 4030-02-300  |                           | 30               |                           | 80                   | 4                        | 20,000                |                  |                         |                          |
| DCLRS 4030-05-160  | R0.5                      | 16               |                           | 60                   | 4                        | 18,000                |                  |                         |                          |
| DCLRS 4030-05-200  |                           | 20               |                           | 60                   | 4                        | 18,000                |                  |                         |                          |
| DCLRS 4030-05-300  |                           | 30               |                           | 80                   | 4                        | 20,000                |                  |                         |                          |
| DCLRS 4040-02-200  | 4                         | R0.2             | 20                        | 8                    | 3.93                     | 16°                   | 60               | 6                       | 20,000                   |
| DCLRS 4040-02-300  |                           |                  | 30                        |                      |                          |                       | 80               | 6                       | 20,000                   |
| DCLRS 4040-02-400  |                           |                  | 40                        |                      |                          |                       | 80               | 6                       | 20,000                   |
| DCLRS 4040-05-200  |                           | R0.5             | 20                        |                      |                          |                       | 60               | 6                       | 20,000                   |
| DCLRS 4040-05-300  |                           |                  | 30                        |                      |                          |                       | 80               | 6                       | 20,000                   |
| DCLRS 4040-05-400  |                           |                  | 40                        |                      |                          |                       | 80               | 6                       | 20,000                   |
| DCLRS 4060-02-300  | 6                         | R0.2             | 30                        | 12                   | 5.93                     | —                     | 100              | 6                       | 23,000                   |
| DCLRS 4060-02-600  |                           |                  | 60                        |                      |                          |                       | 120              | 6                       | 30,000                   |
| DCLRS 4060-05-300  |                           | R0.5             | 30                        |                      |                          |                       | 100              | 6                       | 23,000                   |
| DCLRS 4060-05-600  |                           |                  | 60                        |                      |                          |                       | 120              | 6                       | 30,000                   |

4 Flutes

ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
RadiusTaper Neck  
Radius

Ball

Ball / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral

Spiral  
V Cutter

Drill

Drill

Technical Data

Technical Data

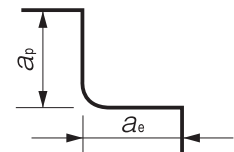
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Milling Conditions for DCLRS

| WORK MATERIAL |                       |                    |                       | GRAPHITE                           |                    |                                 |                                  |
|---------------|-----------------------|--------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>b</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4010-002-060  | 1                     | R0.02              | 6                     | 26,000                             | 1,700              | 0.12                            | 0.7                              |
| 4010-002-100  |                       |                    | 10                    | 22,000                             | 1,300              | 0.12                            | 0.6                              |
| 4010-002-200  |                       |                    | 20                    | 13,000                             | 750                | 0.1                             | 0.5                              |
| 4010-005-060  |                       | R0.05              | 6                     | 26,000                             | 1,700              | 0.12                            | 0.6                              |
| 4010-005-100  |                       |                    | 10                    | 22,000                             | 1,300              | 0.12                            | 0.5                              |
| 4010-005-200  |                       |                    | 20                    | 13,000                             | 750                | 0.1                             | 0.4                              |
| 4015-002-120  | 1.5                   | R0.02              | 12                    | 19,000                             | 1,700              | 0.18                            | 1.1                              |
| 4015-002-200  |                       |                    | 20                    | 15,000                             | 1,300              | 0.14                            | 0.9                              |
| 4015-002-300  |                       |                    | 30                    | 10,000                             | 800                | 0.11                            | 0.7                              |
| 4015-005-120  |                       | R0.05              | 12                    | 19,000                             | 1,700              | 0.18                            | 0.95                             |
| 4015-005-200  |                       |                    | 20                    | 15,000                             | 1,300              | 0.14                            | 0.75                             |
| 4015-005-300  |                       |                    | 30                    | 10,000                             | 800                | 0.11                            | 0.6                              |
| 4020-005-100  | 2                     | R0.05              | 10                    | 20,000                             | 2,400              | 0.3                             | 1.4                              |
| 4020-005-200  |                       |                    | 20                    | 16,000                             | 1,800              | 0.25                            | 1.35                             |
| 4020-02-100   |                       | R0.2               | 10                    | 20,000                             | 2,400              | 0.3                             | 1.2                              |
| 4020-02-200   |                       |                    | 20                    | 16,000                             | 1,800              | 0.25                            | 1.15                             |
| 4020-02-300   |                       |                    | 30                    | 12,000                             | 1,300              | 0.2                             | 1.1                              |
| 4020-05-100   |                       | R0.5               | 10                    | 20,000                             | 2,400              | 0.3                             | 0.95                             |
| 4020-05-200   | 20                    |                    | 16,000                | 1,800                              | 0.25               | 0.9                             |                                  |
| 4020-05-300   | 30                    |                    | 12,000                | 1,300                              | 0.2                | 0.85                            |                                  |
| 4030-005-160  | 3                     | R0.05              | 16                    | 16,500                             | 3,100              | 0.4                             | 2.3                              |
| 4030-005-200  |                       |                    | 20                    | 16,000                             | 2,900              | 0.4                             | 2.1                              |
| 4030-005-300  |                       |                    | 30                    | 14,000                             | 2,300              | 0.4                             | 1.9                              |
| 4030-02-160   |                       | R0.2               | 16                    | 16,500                             | 3,100              | 0.4                             | 2                                |
| 4030-02-200   |                       |                    | 20                    | 16,000                             | 2,900              | 0.4                             | 1.8                              |
| 4030-02-300   |                       |                    | 30                    | 14,000                             | 2,300              | 0.4                             | 1.6                              |
| 4030-05-160   | R0.5                  | 16                 | 16,500                | 3,100                              | 0.4                | 1.7                             |                                  |
| 4030-05-200   |                       | 20                 | 16,000                | 2,900                              | 0.4                | 1.5                             |                                  |
| 4030-05-300   |                       | 30                 | 14,000                | 2,300                              | 0.4                | 1.4                             |                                  |
| 4040-02-200   | 4                     | R0.2               | 20                    | 14,000                             | 3,400              | 0.5                             | 2.7                              |
| 4040-02-300   |                       |                    | 30                    | 13,000                             | 3,000              | 0.5                             | 2.6                              |
| 4040-02-400   |                       |                    | 40                    | 12,000                             | 2,600              | 0.5                             | 2.5                              |
| 4040-05-200   |                       | R0.5               | 20                    | 14,000                             | 3,400              | 0.5                             | 2.3                              |
| 4040-05-300   |                       |                    | 30                    | 13,000                             | 3,000              | 0.5                             | 2.2                              |
| 4040-05-400   |                       |                    | 40                    | 12,000                             | 2,600              | 0.5                             | 2.1                              |
| 4060-02-300   | 6                     | R0.2               | 30                    | 13,000                             | 4,300              | 0.75                            | 4                                |
| 4060-02-600   |                       |                    | 60                    | 10,000                             | 2,800              | 0.75                            | 3.7                              |
| 4060-05-300   |                       | R0.5               | 30                    | 13,000                             | 4,300              | 0.75                            | 3.5                              |
| 4060-05-600   |                       |                    | 60                    | 10,000                             | 2,800              | 0.75                            | 3.1                              |

Note:





- Use a milling machine dedicated for Graphite.
- Recommend air blow for Graphite.



## Other series for Graphite milling

### Square / Long Neck Square






(★ Highly Recommended ● Recommended ○ Suggested)

| Number of Flutes, Tool Type | Model Number | Appearance  | Coating  | Size                   | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Hard Brittle (Non-Metallic) Materials | Page |
|-----------------------------|--------------|---|----------|------------------------|-----------------|----------|--------|----------|-----------------------|---------------------------------------|------|
| 4 flutes Square             | CGE          |  | Non-coat | $\phi 2 \sim \phi 20$  | ○               | ★        | ○      | ○        | ○                     |                                       | 236  |
| 2 flutes Square             | DCES 2000    |  | DIA      | $\phi 0.2 \sim \phi 6$ | ○               | ★        | ○      | ○        | ●                     | ○                                     | 188  |
| 4 flutes Square             | DCES 4000    |  | DIA      | $\phi 3 \sim \phi 10$  | ○               | ★        | ○      | ○        | ●                     | ○                                     | 234  |
| 2 flutes Long Neck Square   | DCLS         |  | DIA      | $\phi 0.4 \sim \phi 6$ | ○               | ★        | ○      | ○        | ●                     | ○                                     | 266  |

### Long Neck Radius

|                           |       |   |     |                      |   |   |   |   |   |   |     |
|---------------------------|-------|---|-----|----------------------|---|---|---|---|---|---|-----|
| 4 flutes Long Neck Radius | DCLRS |  | DIA | $\phi 1 \sim \phi 6$ | ○ | ★ | ○ | ○ | ● | ○ | 396 |
|---------------------------|-------|---|-----|----------------------|---|---|---|---|---|---|-----|

### Ball / Long Neck Ball / Taper Neck Ball

|                          |          |   |          |         |   |   |   |   |   |   |     |
|--------------------------|----------|---|----------|---------|---|---|---|---|---|---|-----|
| 2 flutes Ball            | CGB 2000 |  | Non-coat | R0.2~R6 | ○ | ★ | ○ | ○ | ○ |   | 440 |
| 4 flutes Ball            | CGB 4000 |  | Non-coat | R2~R10  | ○ | ★ | ○ | ○ | ○ |   | 458 |
| 2 flutes Ball            | DCB      |  | DIA      | R0.5~R6 | ○ | ★ | ○ | ○ | ● | ○ | 438 |
| 2 flutes Long Neck Ball  | DCLB     |  | DIA      | R0.2~R3 | ○ | ★ | ○ | ○ | ● | ○ | 512 |
| 2 flutes Taper Neck Ball | DCTNB    |  | DIA      | R0.5~R1 | ○ | ★ | ○ | ○ | ● | ○ | 556 |

4 Flutes

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Square

Long Neck Square

Radius

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Ball

Long Neck Ball

Taper Neck Ball

Taper

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



Size  $\phi 3 \sim \phi 12$

# CXLRS



$\phi 3 \sim \phi 6$

$\phi 8 \sim \phi 12$

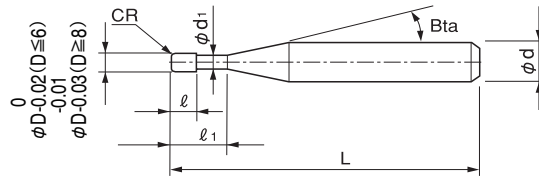
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        | ○         | ○               |          | ●      |          |                       | ○               | ○                     |                  |                                       |

## Features

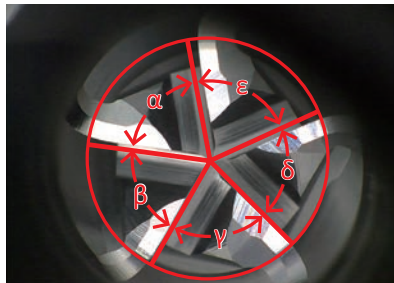
Broad application range from Carbon Steels to Hardened Steels (55HRC).

Variable pitch, variable helix and positive rake angle design offers highly efficient side milling. Seamless Corner Radius design reduces cutting resistance.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

### Variable Pitch

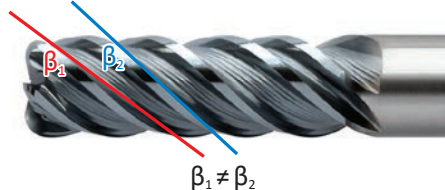


$$\alpha \neq \beta \neq \gamma \neq \delta \neq \epsilon$$

### Seamless Corner Radius



### Variable Helix



$$\beta_1 \neq \beta_2$$

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Total 30 models

Unit (mm)

| Model Number     | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| CXLR5 5030-05-09 | 3                         | R0.5             | 9                         | 6                    | 2.95                     | 16°                   | 50               | 6                       | 10,800                   |
| CXLR5 5030-05-12 |                           |                  | 12                        |                      |                          |                       | 50               |                         |                          |
| CXLR5 5040-05-12 | 4                         | R0.5             | 12                        | 8                    | 3.85                     | 16°                   | 60               | 6                       | 11,600                   |
| CXLR5 5040-05-16 |                           |                  | 16                        |                      |                          |                       | 60               |                         |                          |
| CXLR5 5040-10-12 |                           | R1               | 12                        |                      |                          |                       | 60               |                         |                          |
| CXLR5 5040-10-16 |                           |                  | 16                        |                      |                          |                       | 60               |                         |                          |
| CXLR5 5060-05-18 | 6                         | R0.5             | 18                        | 12                   | 5.85                     | —                     | 70               | 6                       | 13,400                   |
| CXLR5 5060-05-24 |                           |                  | 24                        |                      |                          |                       | 70               |                         |                          |
| CXLR5 5060-10-18 |                           | R1               | 18                        |                      |                          |                       | 70               |                         |                          |
| CXLR5 5060-10-24 |                           |                  | 24                        |                      |                          |                       | 70               |                         |                          |
| CXLR5 5080-05-24 | 8                         | R0.5             | 24                        | 16                   | 7.8                      | —                     | 70               | 8                       | 16,700                   |
| CXLR5 5080-05-32 |                           |                  | 32                        |                      |                          |                       | 70               |                         |                          |
| CXLR5 5080-10-24 |                           | R1               | 24                        |                      |                          |                       | 70               |                         |                          |
| CXLR5 5080-10-32 |                           |                  | 32                        |                      |                          |                       | 70               |                         |                          |
| CXLR5 5100-05-30 | 10                        | R0.5             | 30                        | 20                   | 9.8                      | —                     | 80               | 10                      | 22,000                   |
| CXLR5 5100-05-40 |                           |                  | 40                        |                      |                          |                       | 80               |                         |                          |
| CXLR5 5100-10-30 |                           | R1               | 30                        |                      |                          |                       | 80               |                         |                          |
| CXLR5 5100-10-40 |                           |                  | 40                        |                      |                          |                       | 80               |                         |                          |
| CXLR5 5100-15-30 |                           | R1.5             | 30                        |                      |                          |                       | 80               |                         |                          |
| CXLR5 5100-15-40 |                           |                  | 40                        |                      |                          |                       | 80               |                         |                          |
| CXLR5 5100-20-30 |                           | R2               | 30                        |                      |                          |                       | 80               |                         |                          |
| CXLR5 5100-20-40 |                           |                  | 40                        |                      |                          |                       | 80               |                         |                          |
| CXLR5 5120-05-36 | 12                        | R0.5             | 36                        | 24                   | 11.8                     | —                     | 80               | 12                      | 27,700                   |
| CXLR5 5120-05-48 |                           |                  | 48                        |                      |                          |                       | 100              |                         |                          |
| CXLR5 5120-10-36 |                           | R1               | 36                        |                      |                          |                       | 80               |                         |                          |
| CXLR5 5120-10-48 |                           |                  | 48                        |                      |                          |                       | 100              |                         |                          |
| CXLR5 5120-15-36 |                           | R1.5             | 36                        |                      |                          |                       | 80               |                         |                          |
| CXLR5 5120-15-48 |                           |                  | 48                        |                      |                          |                       | 100              |                         |                          |
| CXLR5 5120-20-36 |                           | R2               | 36                        |                      |                          |                       | 80               |                         |                          |
| CXLR5 5120-20-48 |                           |                  | 48                        |                      |                          |                       | 100              |                         |                          |

5 Flutes

33mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

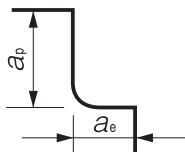
Milling Conditions for CXLRS

| WORK MATERIAL |                       |                       | CARBON STEELS<br>S45C / S50C Annealed Materials<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS<br>SK / SCM Annealed Materials<br>(225~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>HPM / NAK<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT / STAVAX<br>(45~55HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 5030          | 3                     | 9                     | 20,000  | 6,000              | 6                               | 0.24                             | 20,000   | 6,000              | 6                               | 0.24                             | 20,000  | 6,400              | 6                               | 0.09                             | 20,000  | 12,000             | 6                               | 0.05                             |
|               |                       | 12                    | 20,000  | 6,000              | 6                               | 0.19                             | 20,000   | 6,000              | 6                               | 0.19                             | 20,000  | 6,400              | 6                               | 0.07                             | 20,000  | 12,000             | 6                               | 0.04                             |
| 5040          | 4                     | 12                    | 18,200  | 5,460              | 8                               | 0.32                             | 18,200   | 5,460              | 8                               | 0.32                             | 15,900  | 4,770              | 8                               | 0.12                             | 15,000  | 11,500             | 8                               | 0.05                             |
|               |                       | 16                    | 18,200  | 5,460              | 8                               | 0.26                             | 18,200   | 5,460              | 8                               | 0.26                             | 15,900  | 4,770              | 8                               | 0.1                              | 15,000  | 11,500             | 8                               | 0.04                             |
| 5060          | 6                     | 18                    | 12,200  | 5,100              | 12                              | 0.48                             | 12,200   | 5,100              | 12                              | 0.48                             | 12,000  | 5,000              | 12                              | 0.18                             | 10,000  | 7,600              | 12                              | 0.1                              |
|               |                       | 24                    | 12,200  | 5,100              | 12                              | 0.38                             | 12,200   | 5,100              | 12                              | 0.38                             | 12,000  | 5,000              | 12                              | 0.14                             | 10,000  | 7,600              | 12                              | 0.08                             |
| 5080          | 8                     | 24                    | 9,100   | 4,550              | 16                              | 0.64                             | 9,100  | 4,550              | 16                              | 0.64                             | 9,000   | 4,500              | 16                              | 0.32                             | 7,600   | 5,600              | 16                              | 0.15                             |
|               |                       | 32                    | 9,100   | 4,550              | 16                              | 0.51                             | 9,100  | 4,550              | 16                              | 0.51                             | 9,000   | 4,500              | 16                              | 0.26                             | 7,600   | 5,600              | 16                              | 0.12                             |
| 5100          | 10                    | 30                    | 7,300   | 3,650              | 20                              | 0.8                              | 7,300  | 3,650              | 20                              | 0.8                              | 7,300   | 3,650              | 20                              | 0.4                              | 6,000   | 4,500              | 20                              | 0.22                             |
|               |                       | 40                    | 7,300   | 3,650              | 20                              | 0.64                             | 7,300  | 3,650              | 20                              | 0.64                             | 7,300   | 3,650              | 20                              | 0.32                             | 6,000   | 4,500              | 20                              | 0.176                            |
| 5120          | 12                    | 36                    | 6,100   | 3,050              | 24                              | 0.96                             | 6,100  | 3,050              | 24                              | 0.96                             | 6,100   | 3,050              | 24                              | 0.48                             | 5,000   | 3,800              | 24                              | 0.25                             |
|               |                       | 48                    | 6,100   | 3,050              | 24                              | 0.77                             | 6,100  | 3,050              | 24                              | 0.77                             | 6,100   | 3,050              | 24                              | 0.38                             | 5,000   | 3,800              | 24                              | 0.2                              |

Note:

- Please be sure to use water soluble coolant.
- These milling parameters are for reference only. For best result, fine parameter adjustments may be required, depending on the milling shape / application / machine and so on.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- WARNING: Because of high material removal rate, you must pay attention to your chip and coolant management.

Side Milling



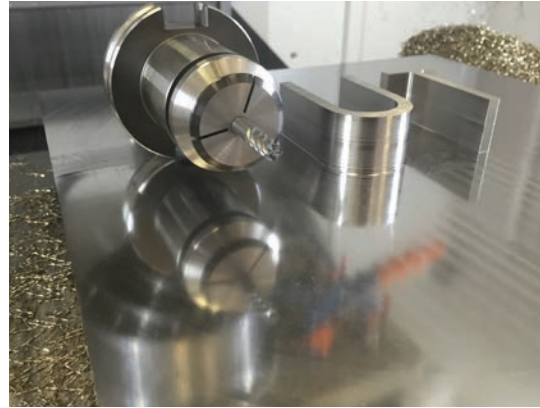
- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Roughing Example : CXLRS  $\phi 6 \times CR0.5 \times EL24$

RAMAX (32HRC)



Size : 500 x 500 mm  
Coolant : Air Blow  
Milling Method : Vortex (Trochoid)



Spindle Speed : 14,000  $\text{min}^{-1}$   
Feed Rate : 7,000 mm/min  
 $a_p$  : 12 mm  
 $a_e$  : 0.5 mm

CXLRS  
Roughing Video



5 Flutes

$\phi 3\text{mm}$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral  
V Cutter

Spiral  
V Cutter

Drill

Drill

Technical Data

Technical Data



Size  $\phi 3 \sim \phi 12$

# HHRS



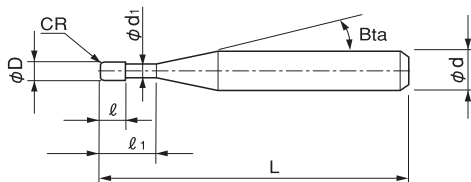
Additional 9 models

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●      | ○      |        | ○      |           |                 | ○        |        |          |                       | ○               | ○                     |                  |                                       |

## Features

Long Neck Radius design for milling on Hard Materials.  
The cutting edge is designed for offering high rigidity.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 23 models

Unit (mm)

| Model Number       | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_i$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Number of Flutes | Suggested Retail Price ¥ |
|--------------------|---------------------------|------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|------------------|--------------------------|
| ※ HHRS 4030-01-100 | 3                         | RO.1             | 10                     | 3                 | 2.95                     | 11°                   | 60               | 6                       | 4                | 7,100                    |
| ※ HHRS 4030-02-100 |                           | RO.2             |                        |                   |                          |                       |                  |                         |                  | 7,100                    |
| ※ HHRS 4030-05-100 |                           | RO.5             |                        |                   |                          |                       |                  |                         |                  | 7,100                    |
| ※ HHRS 4040-01-120 | 4                         | RO.1             | 12                     | 4                 | 3.95                     | 11°                   | 60               | 6                       | 4                | 10,600                   |
| ※ HHRS 4040-02-120 |                           | RO.2             |                        |                   |                          |                       |                  |                         |                  | 10,600                   |
| ※ HHRS 4040-05-120 |                           | RO.5             |                        |                   |                          |                       |                  |                         |                  | 10,600                   |
| ※ HHRS 4040-10-120 |                           | R1               |                        |                   |                          |                       |                  |                         |                  | 10,600                   |
| ※ HHRS 4050-02-160 | 5                         | RO.2             | 16                     | 5                 | 4.95                     | 11°                   | 60               | 6                       | 4                | 14,000                   |
| ※ HHRS 4050-05-160 |                           | RO.5             |                        |                   |                          |                       |                  |                         |                  | 14,000                   |
| HHRS 6060-01-210   | 6                         | RO.1             | 21                     | 6                 | 5.95                     | —                     | 60               | 6                       | 6                | 16,800                   |
| HHRS 6060-02-210   |                           | RO.2             |                        |                   |                          |                       |                  |                         |                  | 16,800                   |
| HHRS 6060-03-210   |                           | RO.3             |                        |                   |                          |                       |                  |                         |                  | 16,800                   |
| HHRS 6060-05-210   |                           | RO.5             |                        |                   |                          |                       |                  |                         |                  | 16,800                   |
| HHRS 6060-10-210   |                           | R1               |                        |                   |                          |                       |                  |                         |                  | 16,800                   |

※Additional model

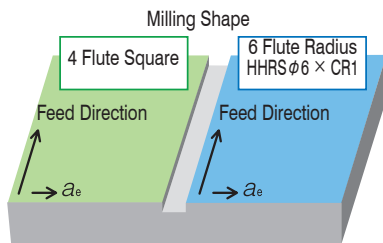


Unit (mm)

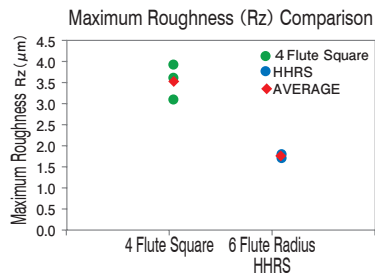
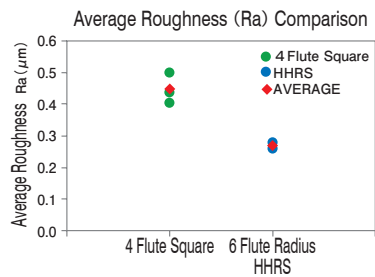
| Model Number     | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Number of Flutes | Suggested Retail Price ¥ |
|------------------|---------------------------|------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|------------------|--------------------------|
| HHRS 6080-03-260 | 8                         | RO.3             | 26                        | 8                    | 7.81                     | —                     | 80               | 8                       | 6                | 21,780                   |
| HHRS 6080-05-260 |                           | RO.5             |                           |                      |                          |                       | 80               | 8                       |                  | 21,780                   |
| HHRS 6080-10-260 |                           | R1               |                           |                      |                          |                       | 80               | 8                       |                  | 21,780                   |
| HHRS 6100-03-310 | 10                        | RO.3             | 31                        | 10                   | 9.81                     | —                     | 80               | 10                      | 6                | 22,990                   |
| HHRS 6100-05-310 |                           | RO.5             |                           |                      |                          |                       | 80               | 10                      |                  | 22,990                   |
| HHRS 6100-10-310 |                           | R1               |                           |                      |                          |                       | 80               | 10                      |                  | 22,990                   |
| HHRS 6120-03-370 | 12                        | RO.3             | 37                        | 12                   | 11.81                    | —                     | 100              | 12                      | 6                | 32,670                   |
| HHRS 6120-05-370 |                           | RO.5             |                           |                      |                          |                       | 100              | 12                      |                  | 32,670                   |
| HHRS 6120-10-370 |                           | R1               |                           |                      |                          |                       | 100              | 12                      |                  | 32,670                   |

**Bottom Surface Milling Comparison between HHRS & 4 Flute Square End Mills NAK80 (40HRC)**

| Spindle Speed           | Feed Rate    | $a_p$   | $a_e$  | Overhang Length | Coolant           |
|-------------------------|--------------|---------|--------|-----------------|-------------------|
| 6,300 min <sup>-1</sup> | 2,650 mm/min | 0.12 mm | 1.2 mm | 22 mm           | Air blow (Nozzle) |



Better bottom surface roughness compared to 4 flute square type.



- 4 Flutes
- 6 Flutes
- $\phi 3mm$  Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for HHRs

### Side Milling

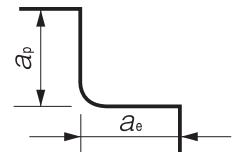
| WORK MATERIAL       |                       | CARBON STEELS<br>S45C / S50C       |                    |            |            | ALLOY STEELS<br>SK / SCM / SUS     |                    |            |            | PREHARDENED STEELS<br>HARDENED STEELS<br>(30~45HRC) |                    |            |            |
|---------------------|-----------------------|------------------------------------|--------------------|------------|------------|------------------------------------|--------------------|------------|------------|---|--------------------|------------|------------|
| Model Number        | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) |
| 4030                | 3                     | 12,600                             | 1,750              | 3          | 0.12       | 12,600                             | 1,750              | 3          | 0.12       | 12,600  | 1,750              | 3          | 0.12       |
| 4040                | 4                     | 9,500                              | 1,750              | 4          | 0.16       | 9,500                              | 1,750              | 4          | 0.16       | 9,500   | 1,750              | 4          | 0.16       |
| 4050                | 5                     | 7,600                              | 1,750              | 5          | 0.2        | 7,600                              | 1,750              | 5          | 0.2        | 7,600   | 1,750              | 5          | 0.2        |
| 6060                | 6                     | 6,300                              | 2,650              | 6          | 0.24       | 6,300                              | 2,650              | 6          | 0.24       | 6,300   | 2,650              | 6          | 0.24       |
| 6080                | 8                     | 4,750                              | 2,650              | 8          | 0.32       | 4,750                              | 2,650              | 8          | 0.32       | 4,750   | 2,650              | 8          | 0.32       |
| 6100                | 10                    | 3,800                              | 2,650              | 10         | 0.4        | 3,800                              | 2,650              | 10         | 0.4        | 3,800   | 2,650              | 10         | 0.4        |
| 6120                | 12                    | 3,150                              | 2,650              | 12         | 0.48       | 3,150                              | 2,650              | 12         | 0.48       | 3,150   | 2,650              | 12         | 0.48       |
| Milling Amount (mm) |                       | $a_p$ : 1D<br>$a_e$ : 0.04D        |                    |            |            | $a_p$ : 1D<br>$a_e$ : 0.04D        |                    |            |            | $a_p$ : 1D<br>$a_e$ : 0.04D                         |                    |            |            |

### Bottom Surface Milling

| WORK MATERIAL       |                       | CARBON STEELS<br>S45C / S50C       |                    |            |            | ALLOY STEELS<br>SK / SCM / SUS     |                    |            |            | PREHARDENED STEELS<br>HARDENED STEELS<br>(30~45HRC) |                    |            |            |
|---------------------|-----------------------|------------------------------------|--------------------|------------|------------|------------------------------------|--------------------|------------|------------|---|--------------------|------------|------------|
| Model Number        | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) |
| 4030                | 3                     | 12,600                             | 1,750              | 0.06       | 0.6        | 12,600                             | 1,750              | 0.06       | 0.6        | 12,600  | 1,750              | 0.06       | 0.6        |
| 4040                | 4                     | 9,500                              | 1,750              | 0.08       | 0.8        | 9,500                              | 1,750              | 0.08       | 0.8        | 9,500   | 1,750              | 0.08       | 0.8        |
| 4050                | 5                     | 7,600                              | 1,750              | 0.1        | 1          | 7,600                              | 1,750              | 0.1        | 1          | 7,600   | 1,750              | 0.1        | 1          |
| 6060                | 6                     | 6,300                              | 2,650              | 0.12       | 1.2        | 6,300                              | 2,650              | 0.12       | 1.2        | 6,300   | 2,650              | 0.12       | 1.2        |
| 6080                | 8                     | 4,750                              | 2,650              | 0.16       | 1.6        | 4,750                              | 2,650              | 0.16       | 1.6        | 4,750   | 2,650              | 0.16       | 1.6        |
| 6100                | 10                    | 3,800                              | 2,650              | 0.2        | 2          | 3,800                              | 2,650              | 0.2        | 2          | 3,800   | 2,650              | 0.2        | 2          |
| 6120                | 12                    | 3,150                              | 2,650              | 0.24       | 2.4        | 3,150                              | 2,650              | 0.24       | 2.4        | 3,150   | 2,650              | 0.24       | 2.4        |
| Milling Amount (mm) |                       | $a_p$ : 0.02D<br>$a_e$ : 0.2D      |                    |            |            | $a_p$ : 0.02D<br>$a_e$ : 0.2D      |                    |            |            | $a_p$ : 0.02D<br>$a_e$ : 0.2D                       |                    |            |            |

**Note:**

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machines maximum speed, or when the tool is chattering and heats up to a red color.
- When milling on a side or bottom surface, set the  $a_p$  amount taking into consideration the remaining corner area.
- Recommend wet coolant for Stainless Steels.



D : Outside Diameter (mm)

## Milling Conditions for HHRS

| WORK MATERIAL       |                       | HARDENED STEELS<br>(45~55HRC)      |                    |            |            | HARDENED STEELS<br>(55~65HRC)                      |                    |            |            |
|---------------------|-----------------------|------------------------------------|--------------------|------------|------------|--|--------------------|------------|------------|
| Model Number        | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Spindle Speed (min <sup>-1</sup> )                 | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) |
| 4030                | 3                     | 9,600                              | 1,300              | 2.4        | 0.06       | 6,400  | 1,000              | 1.5        | 0.015**    |
| 4040                | 4                     | 7,200                              | 1,300              | 3.2        | 0.08       | 4,800  | 1,000              | 2          | 0.02**     |
| 4050                | 5                     | 5,700                              | 1,300              | 4          | 0.1        | 4,000  | 1,000              | 2.5        | 0.025**    |
| 6060                | 6                     | 4,800                              | 2,000              | 4.8        | 0.12       | 3,200  | 1,600              | 3          | 0.06       |
| 6080                | 8                     | 3,600                              | 2,000              | 6.4        | 0.16       | 2,400  | 1,600              | 4          | 0.08       |
| 6100                | 10                    | 2,850                              | 2,000              | 8          | 0.2        | 2,000  | 1,600              | 5          | 0.1        |
| 6120                | 12                    | 2,400                              | 2,000              | 9.6        | 0.24       | 1,600  | 1,600              | 6          | 0.12       |
| Milling Amount (mm) |                       | $a_p$ : 0.8D<br>$a_e$ : 0.02D      |                    |            |            | $a_p$ : 0.5D<br>$a_e$ : 0.01D<br>** $a_e$ : 0.005D |                    |            |            |

| WORK MATERIAL       |                       | HARDENED STEELS<br>(45~55HRC)      |                    |            |            | HARDENED STEELS<br>(55~65HRC)      |                    |            |            |
|---------------------|-----------------------|------------------------------------|--------------------|------------|------------|------------------------------------|--------------------|------------|------------|
| Model Number        | Outside Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) |
| 4030                | 3                     | 9,600                              | 1,300              | 0.045      | 0.6        | 6,400                              | 1,000              | 0.03       | 0.6        |
| 4040                | 4                     | 7,200                              | 1,300              | 0.06       | 0.8        | 4,800                              | 1,000              | 0.04       | 0.8        |
| 4050                | 5                     | 5,700                              | 1,300              | 0.075      | 1          | 4,000                              | 1,000              | 0.05       | 1          |
| 6060                | 6                     | 4,800                              | 2,000              | 0.09       | 1.2        | 3,200                              | 1,600              | 0.06       | 1.2        |
| 6080                | 8                     | 3,600                              | 2,000              | 0.12       | 1.6        | 2,400                              | 1,600              | 0.08       | 1.6        |
| 6100                | 10                    | 2,850                              | 2,000              | 0.15       | 2          | 2,000                              | 1,600              | 0.1        | 2          |
| 6120                | 12                    | 2,400                              | 2,000              | 0.18       | 2.4        | 1,600                              | 1,600              | 0.12       | 2.4        |
| Milling Amount (mm) |                       | $a_p$ : 0.015D<br>$a_e$ : 0.2D     |                    |            |            | $a_p$ : 0.01D<br>$a_e$ : 0.2D      |                    |            |            |

4 Flutes

6 Flutes

ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank Ball

Ball

Long Neck  
BallTaper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 2 \sim \phi 12$

# HGRRS

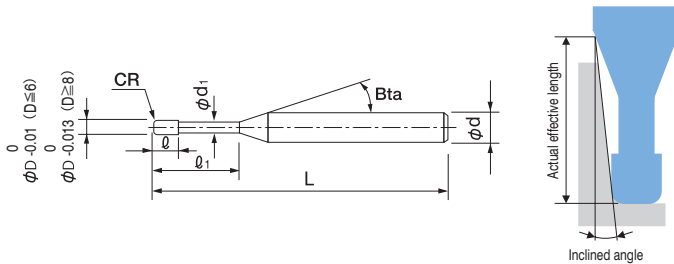
**NEW**



$\phi 2 \sim \phi 6$     $\phi 8 \sim \phi 12$     $\phi 2 \sim \phi 6$     $\phi 8 \sim \phi 12$

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 | ○                                | ●               | ●      | ★      | ●      | ●      |           |                 |          |        |          |                       |                 |                       |                  |                                       |

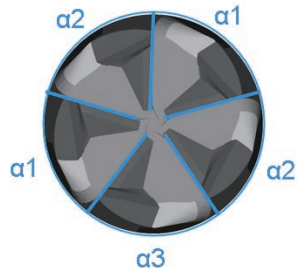


The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

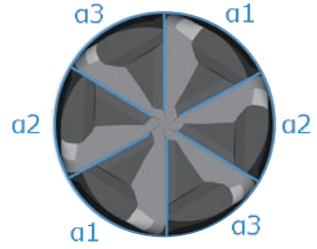
**High efficiency**

Multi-flutes, variable pitch and a short length of cut are some of the features that are very suitable for bottom surface milling.

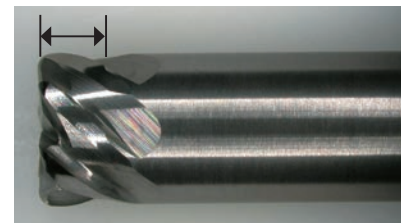
5 Flutes  $\phi 2 \sim \phi 4$



6 Flutes  $\phi 6 \sim \phi 12$



Short length of cut for high rigidity



**High precision**

| Outside Diameter | Diameter Tolerance | Radius Accuracy |
|------------------|--------------------|-----------------|
| $\phi 2 \sim 6$  | <b>0/-0.01</b>     | <b>±0.003</b>   |
| $\phi 8 \sim 12$ | <b>0/-0.013</b>    | <b>±0.005</b>   |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Total 19 models

Unit (mm)

| Model Number       | Outside Diameter $\phi D$ | Corner Radius CR | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Number of Flutes | Suggested Retail Price ¥ |
|--------------------|---------------------------|------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|------------------|--------------------------|
| HGRRS 5020-05-06   | 2                         | R0.5             | 6                      | 1                 | 1.95                     | 16°                   | 50               | 4                       | 5                | 9,920                    |
| HGRRS 5030-08-09   | 3                         | R0.8             | 9                      | 1.5               | 2.95                     | 16°                   | 60               | 4                       | 5                | 10,210                   |
| HGRRS 5040-05-12   | 4                         | R0.5             | 12                     | 2                 | 3.95                     | —                     | 60               | 4                       | 5                | 9,450                    |
| HGRRS 5040-05-12-6 |                           |                  |                        |                   |                          | 16°                   | 60               | 6                       |                  | 10,960                   |
| HGRRS 5040-10-12   |                           | —                |                        |                   |                          | 60                    | 4                | 9,450                   |                  |                          |
| HGRRS 5040-10-12-6 |                           | 16°              |                        |                   |                          | 60                    | 6                | 10,960                  |                  |                          |
| HGRRS 6060-03-18   | 6                         | R0.3             | 18                     | 2.5               | 5.95                     | —                     | 60               | 6                       | 6                | 12,660                   |
| HGRRS 6060-05-18   |                           | R0.5             |                        |                   |                          |                       | 60               | 6                       |                  | 12,660                   |
| HGRRS 6060-10-18   |                           | R1               |                        |                   |                          |                       | 60               | 6                       |                  | 12,660                   |
| HGRRS 6060-15-18   |                           | R1.5             |                        |                   |                          |                       | 60               | 6                       |                  | 12,660                   |
| HGRRS 6080-05-24   | 8                         | R0.5             | 24                     | 3.4               | 7.87                     | —                     | 70               | 8                       | 6                | 15,780                   |
| HGRRS 6080-10-24   |                           | R1               |                        |                   |                          |                       | 70               | 8                       |                  | 15,780                   |
| HGRRS 6080-20-24   |                           | R2               |                        |                   |                          |                       | 70               | 8                       |                  | 15,780                   |
| HGRRS 6100-05-30   | 10                        | R0.5             | 30                     | 4.2               | 9.87                     | —                     | 80               | 10                      | 6                | 20,790                   |
| HGRRS 6100-10-30   |                           | R1               |                        |                   |                          |                       | 80               | 10                      |                  | 20,790                   |
| HGRRS 6100-20-30   |                           | R2               |                        |                   |                          |                       | 80               | 10                      |                  | 20,790                   |
| HGRRS 6120-05-36   | 12                        | R0.5             | 36                     | 5                 | 11.87                    | —                     | 90               | 12                      | 6                | 26,180                   |
| HGRRS 6120-10-36   |                           | R1               |                        |                   |                          |                       | 90               | 12                      |                  | 26,180                   |
| HGRRS 6120-20-36   |                           | R2               |                        |                   |                          |                       | 90               | 12                      |                  | 26,180                   |

Flat surface milling example  
HGRRS  $\phi 6 \times CR0.5 \times EL18$

SKD11 (60HRC)

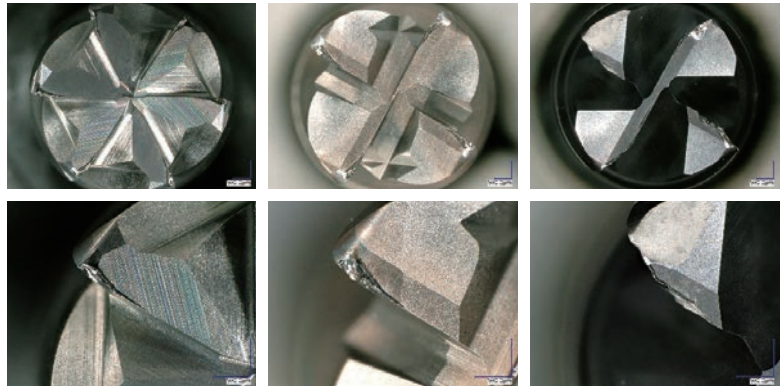
Stable milling and wear resistance are achievable even when using high efficiency milling conditions.

|               |                         |
|---------------|-------------------------|
| Spindle Speed | 3,000 min <sup>-1</sup> |
| Feed Rate     | 6,800 mm/min            |
| $a_p$         | 0.08 mm                 |
| $a_e$         | 4.1 mm                  |
| Work Size     | 100 × 200 × 2.4 mm      |
| Cycle Time    | 30 min                  |

HGRRS

Conventional

Competitor  
Lasted only 10min



Relief wear width (mm)

|       |              |            |
|-------|--------------|------------|
| HGRRS | Conventional | Competitor |
| 0.163 | 0.296        | Chipping   |



$a_e$  4.1mm for a tool diameter of  $\phi 6$ .

5 Flutes

6 Flutes

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel



Spiral  
V Cutter

Drill

Technical Data

Thin cut wide pitch milling  
 $\phi 6 \times C R 0.5$  Compared to catalogue conditions

SKD11 (60HRC)

| Tool Series  | Number of Flutes | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Feed per tooth (mm/t) | $a_p$ (mm) | $a_e$ (mm) | Material Removal Amount (mm <sup>3</sup> /min) |
|--|------------------|------------------------------------|--------------------|-----------------------|------------|------------|--|
| HGRRS<br> | 6 flutes         | 3,000                              | 6,800              | 0.378                 | 0.08       | <b>4.1</b> | 2,230  |
| HRRS<br>  | 4 flutes         | 6,000                              | 2,070              | 0.086                 | 0.11       | 1.08       | 246  |

High efficiency bottom surface milling is possible due to large  $a_e$

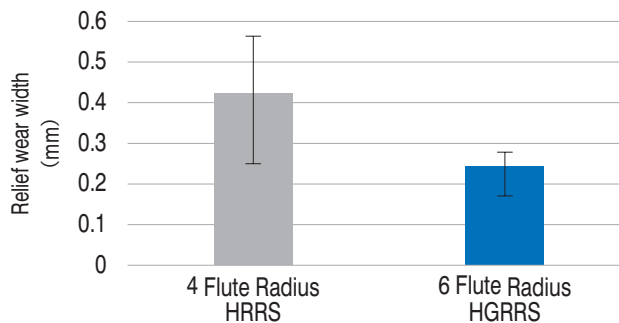
When feed rate cannot be increased  
 $\phi 6 \times C R 0.5$

SKD11 (60HRC)

|                               | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Feed per tooth (mm/t) | $a_p$ (mm) | $a_e$ (mm) | Material Removal Amount (mm <sup>3</sup> /min) |
|-------------------------------|------------------------------------|--------------------|-----------------------|------------|------------|--|
| HGRRS<br>Catalogue conditions | 3,000                              | 6,800              | 0.378                 | 0.08       | 4.1        | 2,230  |



|  |       |              |       |      |      |     |
|--|-------|--------------|-------|------|------|-----|
| Feed rate lowered<br>(Catalogue condition for<br>4 flutes radius HRRS) | 6,000 | <b>2,070</b> | 0.058 | 0.11 | 1.08 | 246 |
|--|-------|--------------|-------|------|------|-----|



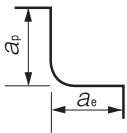
HGRRS display wear resistance even under conditions with low feed rate.

- $\phi 3$ mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for HGRRS

| WORK MATERIAL |                       |                    | PREHARDENED STEELS / HARDENED STEELS / NAK / STAVAX (~55HRC) |                    |                        |                         | HARDENED STEELS SKD11 (55~62HRC)   |                    |                        |                         | HARDENED STEELS HAP10 (62~66HRC)   |                    |                        |                         | HARDENED STEELS HAP72 (66~70HRC)   |                    |                        |                         |
|---------------|-----------------------|--------------------|--|--------------------|------------------------|-------------------------|------------------------------------|--------------------|------------------------|-------------------------|------------------------------------|--------------------|------------------------|-------------------------|------------------------------------|--------------------|------------------------|-------------------------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Spindle Speed (min <sup>-1</sup> )                           | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 5020-05-06    | 2                     | R0.5               | 10,000   | 2,700              | 0.07                   | 0.8                     | 8,000                              | 2,000              | 0.05                   | 0.8                     | 2,640                              | 2,500              | 0.05                   | 0.6                     | 2,400                              | 2,270              | 0.05                   | 0.56                    |
| 5030-08-09    | 3                     | R0.8               | 8,500  | 4,000              | 0.1                    | 1.3                     | 5,500                              | 3,000              | 0.05                   | 1.3                     | 1,980                              | 1,980              | 0.05                   | 0.9                     | 1,800                              | 1,800              | 0.05                   | 0.78                    |
| 5040-05-12    | 4                     | R0.5               | 7,500  | 5,000              | 0.11                   | 1.8                     | 4,300                              | 4,000              | 0.06                   | 1.8                     | 1,540                              | 1,650              | 0.06                   | 1.2                     | 1,400                              | 1,500              | 0.06                   | 1.1                     |
| 5040-05-12-6  |                       |                    | 7,500  | 5,000              | 0.11                   | 1.8                     | 4,300                              | 4,000              | 0.06                   | 1.8                     | 1,540                              | 1,650              | 0.06                   | 1.2                     | 1,400                              | 1,500              | 0.06                   | 1.1                     |
| 5040-10-12    |                       | R1                 | 7,500  | 5,000              | 0.11                   | 1.8                     | 4,300                              | 4,000              | 0.06                   | 1.8                     | 1,540                              | 1,650              | 0.06                   | 1.2                     | 1,400                              | 1,500              | 0.06                   | 1.1                     |
| 5040-10-12-6  |                       |                    | 7,500  | 5,000              | 0.11                   | 1.8                     | 4,300                              | 4,000              | 0.06                   | 1.8                     | 1,540                              | 1,650              | 0.06                   | 1.2                     | 1,400                              | 1,500              | 0.06                   | 1.1                     |
| 6060-03-18    | 6                     | R0.3               | 6,000  | 7,800              | 0.12                   | 4.1                     | 3,000                              | 6,800              | 0.08                   | 4.1                     | 1,100                              | 1,760              | 0.08                   | 1.9                     | 1,000                              | 1,600              | 0.08                   | 1.7                     |
| 6060-05-18    |                       | R0.5               | 6,000  | 7,800              | 0.12                   | 4.1                     | 3,000                              | 6,800              | 0.08                   | 4.1                     | 1,100                              | 1,760              | 0.08                   | 1.9                     | 1,000                              | 1,600              | 0.08                   | 1.7                     |
| 6060-10-18    |                       | R1                 | 6,000  | 7,800              | 0.12                   | 3.6                     | 3,000                              | 6,800              | 0.08                   | 3.6                     | 1,100                              | 1,760              | 0.08                   | 1.9                     | 1,000                              | 1,600              | 0.08                   | 1.7                     |
| 6060-15-18    |                       | R1.5               | 6,000  | 7,800              | 0.12                   | 2.7                     | 3,000                              | 6,800              | 0.08                   | 2.7                     | 1,100                              | 1,760              | 0.08                   | 1.9                     | 1,000                              | 1,600              | 0.08                   | 1.7                     |
| 6080-05-24    | 8                     | R0.5               | 4,800  | 6,600              | 0.12                   | 3.6                     | 2,000                              | 6,300              | 0.08                   | 3.6                     | 830                                | 1,760              | 0.08                   | 2.2                     | 750                                | 1,600              | 0.08                   | 2                       |
| 6080-10-24    |                       | R1                 | 4,800  | 6,600              | 0.12                   | 3.6                     | 2,000                              | 6,300              | 0.08                   | 3.6                     | 830                                | 1,760              | 0.08                   | 2.2                     | 750                                | 1,600              | 0.08                   | 2                       |
| 6080-20-24    |                       | R2                 | 4,800  | 6,600              | 0.2                    | 3.6                     | 2,000                              | 6,300              | 0.08                   | 3.6                     | 830                                | 1,760              | 0.08                   | 2.2                     | 750                                | 1,600              | 0.08                   | 2                       |
| 6100-05-30    |                       | 10                 | R0.5   | 4,300              | 6,200                  | 0.11                    | 5.4                                | 1,500              | 5,800                  | 0.08                    | 5.4                                | 620                | 1,820                  | 0.08                    | 2.5                                | 560                | 1,650                  | 0.08                    |
| 6100-10-30    | R1                    |                    | 4,300  | 6,200              | 0.11                   | 5.4                     | 1,500                              | 5,800              | 0.08                   | 5.4                     | 620                                | 1,820              | 0.08                   | 2.5                     | 560                                | 1,650              | 0.08                   | 2.3                     |
| 6100-20-30    | R2                    |                    | 4,300  | 6,200              | 0.2                    | 5.4                     | 1,500                              | 5,800              | 0.08                   | 5.4                     | 620                                | 1,820              | 0.08                   | 2.5                     | 560                                | 1,650              | 0.08                   | 2.3                     |
| 6120-05-36    | 12                    | R0.5               | 4,000  | 6,000              | 0.1                    | 7.38                    | 1,000                              | 5,200              | 0.08                   | 7.38                    | 360                                | 1,910              | 0.08                   | 3.3                     | 330                                | 1,740              | 0.08                   | 3                       |
| 6120-10-36    |                       | R1                 | 4,000  | 6,000              | 0.1                    | 7.38                    | 1,000                              | 5,200              | 0.08                   | 7.38                    | 360                                | 1,910              | 0.08                   | 3.3                     | 330                                | 1,740              | 0.08                   | 3                       |
| 6120-20-36    |                       | R2                 | 4,000  | 6,000              | 0.2                    | 7.38                    | 1,000                              | 5,200              | 0.08                   | 7.38                    | 360                                | 1,910              | 0.08                   | 3.3                     | 330                                | 1,740              | 0.08                   | 3                       |

- Note:
- Decrease the feed rate more than 50% from the milling parameters when slot milling.
  - Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when chattering and red-hot occur.
  - Every coolant offers stable milling.



5 Flutes

6 Flutes

Ø3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



Size  $\phi 1 \sim \phi 6$

# HTNRS

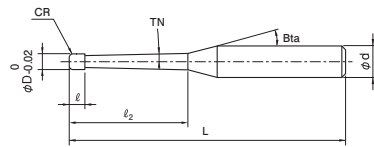
Super MG
HARD MAX
45°
R
 $\pm 0.01$ 
Shank Dia 0/-0.005
Back Taper Geometry
Variable Pitch

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

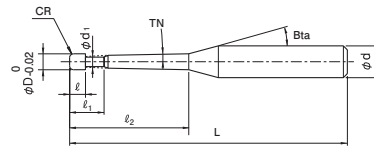
| Work Material |              |                    |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|---------------|--------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels | Alloy Steels | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
| S45C          | SK / SCM     | NAK                | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| S55C          | SUS          | HPM                |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|               |              | ●                  | ●               | ●      | ●      | ○      |        | ○         |                 |          |        |          |                       |                 |                       |                  |                                       |

The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

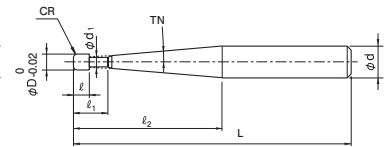
Shape A



Shape B



Shape C



Total 111 models

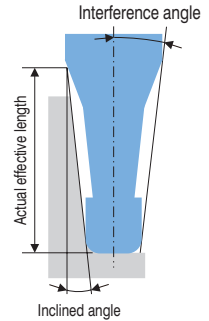
Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Neck Taper Angle TN | Neck Length $l_2$ | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ |
|-------------------|---------------------------|------------------|---------------------|-------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|
| HTNRS 4010-020608 | 1                         | R0.2             | 0.4°                | 6                 | —                      | 1                 | —                        | 16°                   | 50               | 4                       |
| HTNRS 4010-021008 |                           |                  |                     | 10                |                        |                   |                          |                       | 50               | 4                       |
| HTNRS 4010-022008 |                           |                  |                     | 20                |                        |                   |                          |                       | 60               | 4                       |
| HTNRS 4010-023008 |                           |                  |                     | 30                |                        |                   |                          |                       | 70               | 4                       |
| HTNRS 4010-020618 |                           |                  |                     | 6                 |                        |                   |                          |                       | 50               | 4                       |
| HTNRS 4010-021018 |                           |                  |                     | 10                |                        |                   |                          |                       | 50               | 4                       |
| HTNRS 4010-021518 |                           |                  | 15                  | 50                | 4                      |                   |                          |                       |                  |                         |
| HTNRS 4010-022018 |                           |                  | 20                  | 60                | 4                      |                   |                          |                       |                  |                         |
| HTNRS 4010-022518 |                           |                  | 25                  | 60                | 4                      |                   |                          |                       |                  |                         |
| HTNRS 4010-023018 |                           |                  | 30                  | 70                | 4                      |                   |                          |                       |                  |                         |
| HTNRS 4010-023518 |                           |                  | 35                  | 80                | 4                      |                   |                          |                       |                  |                         |
| HTNRS 4010-024018 |                           |                  | 40                  | 80                | 4                      |                   |                          |                       |                  |                         |
| HTNRS 4010-025018 |                           |                  | 50                  | 90                | 4                      |                   |                          |                       |                  |                         |
| HTNRS 4010-020628 |                           |                  | 6                   | 50                | 4                      |                   |                          |                       |                  |                         |
| HTNRS 4010-021028 |                           |                  | 10                  | 50                | 4                      |                   |                          |                       |                  |                         |
| HTNRS 4010-022028 |                           |                  | 20                  | 60                | 4                      |                   |                          |                       |                  |                         |
| HTNRS 4010-023028 | 30                        | 70               | 4                   |                   |                        |                   |                          |                       |                  |                         |



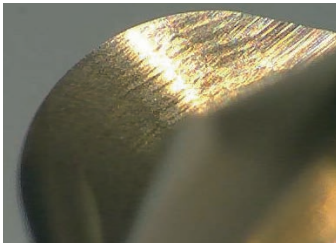
## Features

4 Flute Taper Neck Radius End Mills for milling hard materials. Corner radius design from the edge to the periphery ensures less cutting resistance, and the variable pitch design minimizes chattering and vibration. Can achieve stable milling and excellent surface finish on deep milling. HARDMAX coating offers longer tool life when milling hard materials. Recommended to use with any type of coolant.



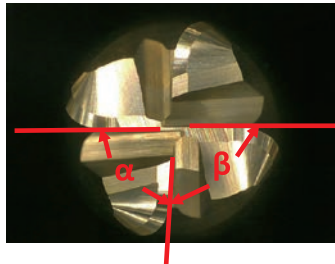
### Feature ①

Seamless Corner Radius  
High rigidity! Less cutting resistance!



### Feature ②

Variable Pitch design  
Minimizing vibration and chattering !



※ Variable Pitch :  $\alpha \neq \beta$

### Feature ③

A wide choice of Taper Neck Angles available  
More efficient with 1.4° · 1.9° · 2.9° !



Unit (mm)

| Model Number      | Outside Diameter<br>$\phi D$ | Corner Radius<br>CR | Neck Taper Angle<br>TN | Neck Length<br>$\phi_2$ | Shape | Suggested Retail Price<br>¥ | Interference Angle | Effective Length by Inclined Angles<br>— : Interference |       |                 |                 |                 |
|-------------------|------------------------------|---------------------|------------------------|-------------------------|-------|-----------------------------|--------------------|---|-------|-----------------|-----------------|-----------------|
|                   |                              |                     |                        |                         |       |                             |                    | 30'   | 1°    | 1°30'           | 2°              | 3°              |
| HTNRS 4010-020608 | 1                            | R0.2                | 0.4°                   | 6                       | A     | 10,000                      | 7.37°              | 6.56  | 6.92  | 7.20            | 7.45            | 8.00            |
| HTNRS 4010-021008 |                              |                     |                        | 10                      |       | 10,000                      | 5.54°              | 10.61   | 11.12 | 11.50           | 11.89           | 12.77           |
| HTNRS 4010-022008 |                              |                     |                        | 20                      |       | 10,000                      | 3.42°              | 20.73   | 21.52 | 22.24           | 23.00           | 24.71           |
| HTNRS 4010-023008 |                              |                     |                        | 30                      |       | 12,000                      | 2.47°              | 30.83   | 31.91 | 32.97           | 34.11           | No Interference |
| HTNRS 4010-020618 |                              |                     |                        | 6                       |       | 10,000                      | 7.49°              | —   | 6.61  | 6.96            | 7.23            | 7.76            |
| HTNRS 4010-021018 |                              |                     |                        | 10                      |       | 10,000                      | 5.65°              | —   | 10.66 | 11.15           | 11.53           | 12.38           |
| HTNRS 4010-021518 |                              |                     | 15                     | 10,000                  |       | 4.33°                       | —                  | 15.72   | 16.35 | 16.92           | 18.17           |                 |
| HTNRS 4010-022018 |                              |                     | 20                     | 10,000                  |       | 3.50°                       | —                  | 20.77   | 21.56 | 22.30           | 23.95           |                 |
| HTNRS 4010-022518 |                              |                     | 25                     | 10,000                  |       | 2.94°                       | —                  | 25.82   | 26.76 | 27.68           | No Interference |                 |
| HTNRS 4010-023018 |                              |                     | 30                     | 12,000                  |       | 2.54°                       | —                  | 30.87   | 31.96 | 33.06           | No Interference |                 |
| HTNRS 4010-023518 |                              |                     | 35                     | 14,000                  |       | 2.23°                       | —                  | 35.92   | 37.16 | 38.44           | No Interference |                 |
| HTNRS 4010-024018 |                              |                     | 40                     | 14,000                  |       | 1.99°                       | —                  | 40.96   | 42.36 | No Interference | No Interference |                 |
| HTNRS 4010-025018 |                              |                     | 50                     | 15,000                  |       | 1.64°                       | —                  | 51.02   | 52.74 | No Interference | No Interference |                 |
| HTNRS 4010-020628 |                              |                     | 6                      | 10,000                  |       | 7.61°                       | —                  | —   | 6.66  | 7.00            | 7.53            |                 |
| HTNRS 4010-021028 |                              |                     | 10                     | 10,000                  |       | 5.77°                       | —                  | —   | 10.71 | 11.18           | 12.00           |                 |
| HTNRS 4010-022028 |                              |                     | 20                     | 10,000                  |       | 3.59°                       | —                  | —   | 20.81 | 21.59           | 23.20           |                 |
| HTNRS 4010-023028 |                              |                     | 30                     | 12,000                  |       | 2.61°                       | —                  | —   | 30.91 | 32.01           | No Interference |                 |

Next Page →

4 Flutes

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Unit (mm)

| Model Number       | Outside Diameter $\phi D$ | Corner Radius CR | Neck Taper Angle TN | Neck Length $\ell_2$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ |      |     |    |   |
|--------------------|---------------------------|------------------|---------------------|----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|------|-----|----|---|
| HTNRS 40125-020618 | 1.25                      | R0.2             | 0.9°                | 6                    | —                         | 1.25                 | —                        | 16°                   | 50               | 4                       |      |     |    |   |
| HTNRS 40125-021018 |                           |                  |                     | 10                   |                           |                      |                          |                       | 50               | 4                       |      |     |    |   |
| HTNRS 40125-021518 |                           |                  |                     | 15                   |                           |                      |                          |                       | 50               | 4                       |      |     |    |   |
| HTNRS 40125-022018 |                           |                  |                     | 20                   |                           |                      |                          |                       | 60               | 4                       |      |     |    |   |
| HTNRS 40125-023018 |                           |                  |                     | 30                   |                           |                      |                          |                       | 70               | 4                       |      |     |    |   |
| HTNRS 40125-024018 |                           |                  |                     | 40                   |                           |                      |                          |                       | 80               | 4                       |      |     |    |   |
| HTNRS 40125-025018 |                           |                  |                     | 50                   |                           |                      |                          |                       | 90               | 4                       |      |     |    |   |
| HTNRS 4015-030608  | 1.5                       | R0.3             | 0.4°                | 6                    | —                         | 1.5                  | —                        | 16°                   | 50               | 4                       |      |     |    |   |
| HTNRS 4015-031008  |                           |                  |                     | 10                   |                           |                      |                          |                       | 50               | 4                       |      |     |    |   |
| HTNRS 4015-032008  |                           |                  |                     | 20                   |                           |                      |                          |                       | 60               | 4                       |      |     |    |   |
| HTNRS 4015-033008  |                           |                  |                     | 30                   |                           |                      |                          |                       | 70               | 4                       |      |     |    |   |
| HTNRS 4015-030618  |                           |                  | 0.9°                | 6                    |                           |                      |                          |                       | —                | 1.5                     | —    | 16° | 50 | 4 |
| HTNRS 4015-031018  |                           |                  |                     | 10                   |                           |                      |                          |                       |                  |                         |      |     | 50 | 4 |
| HTNRS 4015-031518  |                           |                  |                     | 15                   |                           |                      |                          |                       |                  |                         |      |     | 50 | 4 |
| HTNRS 4015-032018  |                           |                  |                     | 20                   |                           |                      |                          |                       |                  |                         |      |     | 60 | 4 |
| HTNRS 4015-032518  |                           |                  |                     | 25                   |                           |                      |                          |                       |                  |                         |      |     | 60 | 4 |
| HTNRS 4015-033018  |                           |                  |                     | 30                   |                           |                      |                          |                       |                  |                         |      |     | 70 | 4 |
| HTNRS 4015-034018  |                           |                  | 40                  | 80                   |                           |                      |                          |                       | 4                |                         |      |     |    |   |
| HTNRS 4015-035018  |                           |                  | 50                  | 90                   |                           |                      |                          |                       | 4                |                         |      |     |    |   |
| HTNRS 4015-030628  |                           |                  | 1.4°                | 6                    |                           |                      |                          |                       | 2.7              | 1.43                    | 1.43 | 16° | 50 | 4 |
| HTNRS 4015-031028  |                           |                  |                     | 10                   |                           |                      |                          |                       |                  |                         |      |     | 50 | 4 |
| HTNRS 4015-032028  | 20                        | 60               |                     | 4                    |                           |                      |                          |                       |                  |                         |      |     |    |   |
| HTNRS 4015-033028  | 30                        | 70               |                     | 4                    |                           |                      |                          |                       |                  |                         |      |     |    |   |
| HTNRS 40175-030618 | 1.75                      | R0.3             | 0.9°                | 6                    | —                         | 1.75                 | —                        | 16°                   | 50               | 4                       |      |     |    |   |
| HTNRS 40175-031018 |                           |                  |                     | 10                   |                           |                      |                          |                       | 50               | 4                       |      |     |    |   |
| HTNRS 40175-031518 |                           |                  |                     | 15                   |                           |                      |                          |                       | 60               | 4                       |      |     |    |   |
| HTNRS 40175-032018 |                           |                  |                     | 20                   |                           |                      |                          |                       | 60               | 4                       |      |     |    |   |
| HTNRS 40175-033018 |                           |                  |                     | 30                   |                           |                      |                          |                       | 70               | 4                       |      |     |    |   |
| HTNRS 40175-034018 |                           |                  |                     | 40                   |                           |                      |                          |                       | 80               | 4                       |      |     |    |   |
| HTNRS 40175-035018 |                           |                  |                     | 50                   |                           |                      |                          |                       | 90               | 4                       |      |     |    |   |
| HTNRS 4020-052008  | 2                         | R0.5             | 0.4°                | 20                   | —                         | 2                    | —                        | 16°                   | 60               | 4                       |      |     |    |   |
| HTNRS 4020-052608  |                           |                  |                     | 26                   |                           |                      |                          |                       | 60               | 4                       |      |     |    |   |
| HTNRS 4020-053008  |                           |                  |                     | 30                   |                           |                      |                          |                       | 70               | 4                       |      |     |    |   |
| HTNRS 4020-053608  |                           |                  |                     | 36                   |                           |                      |                          |                       | 80               | 4                       |      |     |    |   |
| HTNRS 4020-054008  |                           |                  |                     | 40                   |                           |                      |                          |                       | 80               | 4                       |      |     |    |   |
| HTNRS 4020-051018  |                           |                  |                     | 10                   |                           |                      |                          |                       | 60               | 4                       |      |     |    |   |
| HTNRS 4020-051518  |                           |                  | 15                  | 60                   |                           |                      |                          |                       | 4                |                         |      |     |    |   |
| HTNRS 4020-052018  |                           |                  | 20                  | 60                   |                           |                      |                          |                       | 4                |                         |      |     |    |   |
| HTNRS 4020-052518  |                           |                  | 25                  | 60                   |                           |                      |                          |                       | 4                |                         |      |     |    |   |
| HTNRS 4020-053018  |                           |                  | 30                  | 70                   |                           |                      |                          |                       | 4                |                         |      |     |    |   |
| HTNRS 4020-053518  |                           |                  | 35                  | 80                   |                           |                      |                          |                       | 4                |                         |      |     |    |   |
| HTNRS 4020-054018  |                           |                  | 40                  | 80                   |                           |                      |                          |                       | 4                |                         |      |     |    |   |
| HTNRS 4020-054518  |                           |                  | 45                  | 90                   |                           |                      |                          |                       | 4                |                         |      |     |    |   |
| HTNRS 4020-055018  |                           |                  | 50                  | 90                   |                           |                      |                          |                       | 4                |                         |      |     |    |   |
| HTNRS 4020-053028  |                           |                  | 1.4°                | 30                   |                           |                      |                          |                       | 3.6              | 1.9                     | 1.9  | 70  | 4  |   |
| HTNRS 4020-054028  |                           |                  |                     | 40                   |                           |                      |                          |                       |                  |                         |      | 80  | 4  |   |
| HTNRS 4020-053038  |                           |                  |                     | 1.9°                 |                           |                      |                          |                       |                  |                         |      | 30  | 70 | 6 |
| HTNRS 4020-054038  |                           |                  | 40                  |                      |                           |                      |                          |                       | 80               | 6                       |      |     |    |   |
| HTNRS 4020-053058  |                           |                  | 2.9°                | 30                   |                           |                      |                          |                       | —                | —                       | —    | 70  | 6  |   |
| HTNRS 4020-054258  |                           |                  |                     | 42                   |                           |                      |                          |                       |                  |                         |      | 90  | 6  |   |

- $\phi 3\text{mm}$  Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Unit (mm)

| Model Number       | Outside Diameter $\phi D$ | Corner Radius CR | Neck Taper Angle TN | Neck Length $\ell_2$ | Shape | Suggested Retail Price ¥ | Interference Angle | Effective Length by Inclined Angles<br>— : Interference |        |                 |                 |                 |                 |
|--------------------|---------------------------|------------------|---------------------|----------------------|-------|--------------------------|--------------------|---|--------|-----------------|-----------------|-----------------|-----------------|
|                    |                           |                  |                     |                      |       |                          |                    | 30'   | 1°     | 1°30'           | 2°              | 3°              |                 |
| HTNRS 40125-020618 | 1.25                      | RO.2             | 0.9°                | 6                    | A     | 10,000                   | 7.14°              | —   | 6.63   | 6.97            | 7.24            | 7.77            |                 |
| HTNRS 40125-021018 |                           |                  |                     | 10                   |       | 10,000                   | 5.34°              | —   | 10.68  | 11.16           | 11.55           | 12.40           |                 |
| HTNRS 40125-021518 |                           |                  |                     | 15                   |       | 10,000                   | 4.05°              | —   | 15.74  | 16.37           | 16.93           | 18.18           |                 |
| HTNRS 40125-022018 |                           |                  |                     | 20                   |       | 10,000                   | 3.27°              | —   | 20.79  | 21.57           | 22.31           | 23.96           |                 |
| HTNRS 40125-023018 |                           |                  |                     | 30                   |       | 12,000                   | 2.36°              | —   | 30.89  | 31.97           | 33.07           | No Interference |                 |
| HTNRS 40125-024018 |                           |                  |                     | 40                   |       | 14,000                   | 1.84°              | —   | 40.97  | 42.37           | No Interference | No Interference |                 |
| HTNRS 40125-025018 |                           |                  |                     | 50                   |       | 15,000                   | 1.51°              | —   | 51.03  | 52.75           | No Interference | No Interference |                 |
| HTNRS 4015-030608  | 1.5                       | RO.3             | 0.4°                | 6                    | A     | 10,000                   | 6.69°              | 6.62  | 6.96   | 7.23            | 7.47            | 8.01            |                 |
| HTNRS 4015-031008  |                           |                  |                     | 10                   |       | 10,000                   | 4.92°              | 10.66   | 11.15  | 11.52           | 11.91           | 12.79           |                 |
| HTNRS 4015-032008  |                           |                  |                     | 20                   |       | 10,000                   | 2.96°              | 20.78   | 21.55  | 22.26           | 23.03           | No Interference |                 |
| HTNRS 4015-033008  |                           |                  |                     | 30                   |       | 12,000                   | 2.12°              | 30.87   | 31.94  | 33.00           | 34.13           | No Interference |                 |
| HTNRS 4015-030618  |                           |                  | 0.9°                | 6                    |       | 10,000                   | 6.80°              | —   | 6.69   | 7.01            | 7.27            | 7.79            |                 |
| HTNRS 4015-031018  |                           |                  |                     | 10                   |       | 10,000                   | 5.03°              | —   | 10.73  | 11.19           | 11.57           | 12.42           |                 |
| HTNRS 4015-031518  |                           |                  |                     | 15                   |       | 10,000                   | 3.79°              | —   | 15.79  | 16.39           | 16.95           | 18.20           |                 |
| HTNRS 4015-032018  |                           |                  | 1.4°                | 20                   |       | 10,000                   | 3.04°              | —   | 20.84  | 21.60           | 22.34           | 23.99           |                 |
| HTNRS 4015-032518  |                           |                  |                     | 25                   |       | 10,000                   | 2.54°              | —   | 25.88  | 26.80           | 27.72           | No Interference |                 |
| HTNRS 4015-033018  |                           |                  |                     | 30                   |       | 12,000                   | 2.18°              | —   | 30.93  | 32.00           | 33.10           | No Interference |                 |
| HTNRS 4015-034018  |                           |                  |                     | 40                   |       | 14,000                   | 1.70°              | —   | 41.01  | 42.40           | No Interference | No Interference |                 |
| HTNRS 4015-035018  |                           |                  |                     | 50                   |       | 15,000                   | 1.39°              | —   | 51.07  | No Interference | No Interference | No Interference |                 |
| HTNRS 4015-030628  |                           |                  | 0.9°                | 6                    |       | B                        | 10,000             | 6.92°   | —      | —               | 6.76            | 7.06            | 7.58            |
| HTNRS 4015-031028  |                           |                  |                     | 10                   |       |                          | 10,000             | 5.13°   | —      | —               | 10.80           | 11.23           | 12.05           |
| HTNRS 4015-032028  |                           |                  |                     | 20                   |       |                          | 10,000             | 3.12°   | —      | —               | 20.89           | 21.65           | 23.25           |
| HTNRS 4015-033028  |                           |                  |                     | 30                   |       |                          | 12,000             | 2.24°   | —      | —               | 30.98           | 32.07           | No Interference |
| HTNRS 40175-030618 |                           |                  | 1.75                | RO.3                 |       | 0.9°                     | 6                  | A   | 10,000 | 6.37°           | —               | 6.75            | 7.06            |
| HTNRS 40175-031018 | 10                        | 10,000           |                     |                      | 4.66° |                          | —                  |   | 10.79  | 11.23           | 11.61           | 12.46           |                 |
| HTNRS 40175-031518 | 15                        | 10,000           |                     |                      | 3.49° |                          | —                  |   | 15.84  | 16.43           | 16.99           | 18.24           |                 |
| HTNRS 40175-032018 | 20                        | 10,000           |                     |                      | 2.78° |                          | —                  |   | 20.89  | 21.63           | 22.38           | No Interference |                 |
| HTNRS 40175-033018 | 30                        | 12,000           |                     |                      | 1.99° |                          | —                  |   | 30.98  | 32.04           | No Interference | No Interference |                 |
| HTNRS 40175-034018 | 40                        | 14,000           |                     |                      | 1.54° |                          | —                  |   | 41.06  | 42.44           | No Interference | No Interference |                 |
| HTNRS 40175-035018 | 50                        | 15,000           |                     |                      | 1.26° |                          | —                  |   | 51.11  | No Interference | No Interference | No Interference |                 |
| HTNRS 4020-052008  | 2                         | RO.5             | 0.4°                | 20                   | A     | 11,000                   | 2.48°              | 20.86   | 21.60  | 22.30           | 23.06           | No Interference |                 |
| HTNRS 4020-052608  |                           |                  |                     | 26                   |       | 11,000                   | 1.98°              | 26.92   | 27.83  | 28.75           | No Interference | No Interference |                 |
| HTNRS 4020-053008  |                           |                  |                     | 30                   |       | 11,000                   | 1.75°              | 30.95   | 31.98  | 33.04           | No Interference | No Interference |                 |
| HTNRS 4020-053608  |                           |                  |                     | 36                   |       | 14,000                   | 1.49°              | 37.00   | 38.22  | No Interference | No Interference | No Interference |                 |
| HTNRS 4020-054008  |                           |                  |                     | 40                   |       | 14,000                   | 1.35°              | 41.03   | 42.37  | No Interference | No Interference | No Interference |                 |
| HTNRS 4020-051018  |                           |                  |                     | 0.9°                 |       | 10                       | 11,000             | 4.33°   | —      | 10.84           | 11.25           | 11.63           | 12.46           |
| HTNRS 4020-051518  |                           |                  |                     |                      |       | 15                       | 11,000             | 3.21°   | —      | 15.88           | 16.45           | 17.01           | 18.25           |
| HTNRS 4020-052018  |                           |                  | 20                  |                      |       | 11,000                   | 2.54°              | —   | 20.93  | 21.66           | 22.39           | No Interference |                 |
| HTNRS 4020-052518  |                           |                  | 25                  |                      |       | 11,000                   | 2.11°              | —   | 25.97  | 26.86           | 27.77           | No Interference |                 |
| HTNRS 4020-053018  |                           |                  | 30                  |                      |       | 11,000                   | 1.80°              | —   | 31.01  | 32.06           | No Interference | No Interference |                 |
| HTNRS 4020-053518  |                           |                  | 35                  |                      |       | 14,000                   | 1.57°              | —   | 36.05  | 37.26           | No Interference | No Interference |                 |
| HTNRS 4020-054018  |                           |                  | 1.4°                | 40                   |       | 14,000                   | 1.39°              | —   | 41.09  | No Interference | No Interference | No Interference |                 |
| HTNRS 4020-054518  |                           |                  |                     | 45                   |       | 15,000                   | 1.25°              | —   | 46.10  | No Interference | No Interference | No Interference |                 |
| HTNRS 4020-055018  |                           |                  |                     | 50                   |       | 15,000                   | 1.14°              | —   | 51.14  | No Interference | No Interference | No Interference |                 |
| HTNRS 4020-053028  |                           |                  | 1.9°                | 30                   |       | B                        | 11,000             | 1.85°   | —      | —               | 31.07           | No Interference | No Interference |
| HTNRS 4020-054028  |                           |                  |                     | 40                   |       |                          | 14,000             | 1.43°   | —      | —               | No Interference | No Interference | No Interference |
| HTNRS 4020-053038  |                           |                  |                     | 30                   |       |                          | 12,000             | 3.39°   | —      | —               | —               | 31.12           | 33.41           |
| HTNRS 4020-054038  |                           |                  | 2.9°                | 40                   |       | 15,000                   | 2.69°              | —   | —      | —               | 41.19           | No Interference |                 |
| HTNRS 4020-053058  |                           |                  |                     | 30                   |       | 12,000                   | 3.58°              | —   | —      | —               | —               | 31.23           |                 |
| HTNRS 4020-054258  |                           |                  | 42                  | C                    |       | 16,500                   | 2.74°              | —   | —      | —               | —               | No Interference |                 |

- 4 Flutes
- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Square
- Long Neck Square
- Radius
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Neck Taper Angle TN | Neck Length $\ell_2$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ |   |   |     |      |      |     |      |      |     |     |   |
|-------------------|---------------------------|------------------|---------------------|----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|---|---|-----|------|------|-----|------|------|-----|-----|---|
| HTNRS 4030-082008 | 3                         | R0.8             | 0.4°                | 20                   | —                         | 3                    | —                        | 16°                   | 60               | 6                       |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4030-082608 |                           |                  |                     | 26                   |                           |                      |                          |                       | 60               | 6                       |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4030-083008 |                           |                  |                     | 30                   |                           |                      |                          |                       | 70               | 6                       |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4030-083608 |                           |                  |                     | 36                   |                           |                      |                          |                       | 80               | 6                       |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4030-084008 |                           |                  |                     | 40                   |                           |                      |                          |                       | 80               | 6                       |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4030-082018 |                           |                  | 20                  | 0.9°                 |                           |                      |                          |                       | 0.9°             | —                       | 3 | — | 16° | 60   | 6    |     |      |      |     |     |   |
| HTNRS 4030-082518 |                           |                  | 25                  |                      |                           |                      |                          |                       |                  |                         |   |   |     | 60   | 6    |     |      |      |     |     |   |
| HTNRS 4030-083018 |                           |                  | 30                  |                      |                           |                      |                          |                       |                  |                         |   |   |     | 70   | 6    |     |      |      |     |     |   |
| HTNRS 4030-083518 |                           |                  | 35                  |                      |                           |                      |                          |                       |                  |                         |   |   |     | 80   | 6    |     |      |      |     |     |   |
| HTNRS 4030-084018 |                           |                  | 40                  |                      |                           |                      |                          |                       |                  |                         |   |   |     | 80   | 6    |     |      |      |     |     |   |
| HTNRS 4030-085018 |                           |                  | 50                  |                      |                           |                      |                          |                       |                  |                         |   |   |     | 90   | 6    |     |      |      |     |     |   |
| HTNRS 4030-086018 |                           |                  | 60                  |                      |                           |                      |                          |                       |                  |                         |   |   |     | 100  | 6    |     |      |      |     |     |   |
| HTNRS 4030-083028 |                           |                  | 30                  |                      |                           |                      |                          |                       |                  |                         |   |   |     | 1.4° | 1.4° | 4.5 | 2.89 | 2.89 | —   | 70  | 6 |
| HTNRS 4030-084028 |                           |                  | 40                  |                      |                           |                      |                          |                       |                  |                         |   |   |     |      |      |     |      |      |     | 80  | 6 |
| HTNRS 4030-083038 |                           |                  | 30                  |                      |                           |                      |                          |                       |                  |                         |   |   |     |      |      |     |      |      |     | 70  | 6 |
| HTNRS 4030-084038 |                           |                  | 40                  | 80                   |                           |                      |                          |                       | 6                |                         |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4030-083358 | 33                        | 2.9°             | 2.9°                | 33                   | —                         | —                    | 80                       | 6                     |                  |                         |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4040-102508 | 4                         | R1               | 0.4°                | 25                   | —                         | 4                    | —                        | 16°                   | 60               | 6                       |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4040-103008 |                           |                  |                     | 30                   |                           |                      |                          |                       | 70               | 6                       |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4040-103508 |                           |                  |                     | 35                   |                           |                      |                          |                       | 80               | 6                       |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4040-104008 |                           |                  |                     | 40                   |                           |                      |                          |                       | 80               | 6                       |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4040-104508 |                           |                  |                     | 45                   |                           |                      |                          |                       | 90               | 6                       |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4040-105008 |                           |                  |                     | 50                   |                           |                      |                          |                       | 90               | 6                       |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4040-102018 |                           |                  |                     | 20                   |                           |                      |                          |                       | 0.9°             | 0.9°                    | — | 4 | —   | 16°  | 60   | 6   |      |      |     |     |   |
| HTNRS 4040-102518 |                           |                  |                     | 25                   |                           |                      |                          |                       |                  |                         |   |   |     |      | 60   | 6   |      |      |     |     |   |
| HTNRS 4040-103018 |                           |                  |                     | 30                   |                           |                      |                          |                       |                  |                         |   |   |     |      | 70   | 6   |      |      |     |     |   |
| HTNRS 4040-103518 |                           |                  |                     | 35                   |                           |                      |                          |                       |                  |                         |   |   |     |      | 80   | 6   |      |      |     |     |   |
| HTNRS 4040-104018 |                           |                  | 40                  | 80                   |                           |                      |                          |                       |                  |                         |   |   |     |      | 6    |     |      |      |     |     |   |
| HTNRS 4040-105018 |                           |                  | 50                  | 90                   |                           |                      |                          |                       |                  |                         |   |   |     |      | 6    |     |      |      |     |     |   |
| HTNRS 4040-106018 |                           |                  | 60                  | 100                  |                           |                      |                          |                       |                  |                         |   |   |     |      | 6    |     |      |      |     |     |   |
| HTNRS 4040-104928 |                           |                  | 49                  | 1.4°                 |                           |                      |                          |                       |                  |                         |   |   |     |      | 1.4° | 6   | 3.8  | 3.8  | 16° | 90  | 6 |
| HTNRS 4040-106028 |                           |                  | 60                  |                      |                           |                      |                          |                       |                  |                         |   |   |     |      |      |     |      |      |     | 100 | 8 |
| HTNRS 4040-103038 |                           |                  | 30                  |                      |                           |                      |                          |                       |                  |                         |   |   |     |      |      |     |      |      |     | 70  | 8 |
| HTNRS 4040-106738 |                           |                  | 67                  |                      |                           |                      |                          |                       | 120              | 8                       |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4040-104558 |                           |                  | 45                  | 2.9°                 |                           |                      |                          |                       | 2.9°             | 45                      | — | — | 90  | 8    |      |     |      |      |     |     |   |
| HTNRS 4060-152018 |                           |                  | 6                   | R1.5                 |                           |                      |                          |                       | 0.9°             | 20                      | — | 6 | —   | 16°  | 60   | 8   |      |      |     |     |   |
| HTNRS 4060-153018 |                           |                  |                     |                      |                           |                      |                          |                       |                  | 30                      |   |   |     |      | 70   | 8   |      |      |     |     |   |
| HTNRS 4060-154018 | 40                        | 80               |                     |                      | 8                         |                      |                          |                       |                  |                         |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4060-155018 | 50                        | 90               |                     |                      | 8                         |                      |                          |                       |                  |                         |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4060-156018 | 60                        | 100              |                     |                      | 8                         |                      |                          |                       |                  |                         |   |   |     |      |      |     |      |      |     |     |   |
| HTNRS 4060-155128 | 51                        | 1.4°             |                     |                      | 1.4°                      | 9                    | 5.8                      | 5.8                   | —                | 90                      |   |   |     |      | 8    |     |      |      |     |     |   |
| HTNRS 4060-153938 | 39                        |                  |                     |                      |                           |                      |                          |                       |                  | 80                      |   |   |     |      | 8    |     |      |      |     |     |   |
| HTNRS 4060-156938 | 69                        |                  |                     |                      |                           |                      |                          |                       |                  | 110                     |   |   |     |      | 10   |     |      |      |     |     |   |
| HTNRS 4060-154758 | 47                        |                  |                     |                      |                           |                      |                          |                       |                  | 90                      |   |   |     |      | 10   |     |      |      |     |     |   |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square Long Neck Square

Radius Long Neck Radius Taper Neck Radius

Ball / Long Shank Ball Long Neck Ball Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Unit (mm)

| Model Number      | Outside Diameter $\phi D$ | Corner Radius CR | Neck Taper Angle TN | Neck Length $\ell_2$ | Shape  | Suggested Retail Price ¥ | Interference Angle | Effective Length by Inclined Angles — : Interference |                 |                 |                 |                 |
|-------------------|---------------------------|------------------|---------------------|----------------------|--------|--------------------------|--------------------|--|-----------------|-----------------|-----------------|-----------------|
|                   |                           |                  |                     |                      |        |                          |                    | 30'  | 1°              | 1°30'           | 2°              | 3°              |
| HTNRS 4030-082008 | 3                         | R0.8             | 0.4°                | 20                   | A      | 12,000                   | 3.48°              | 20.88  | 21.60           | 22.30           | 23.05           | 24.72           |
| HTNRS 4030-082608 |                           |                  |                     | 26                   |        | 12,000                   | 2.82°              | 26.94  | 27.84           | 28.74           | 29.72           | No Interference |
| HTNRS 4030-083008 |                           |                  |                     | 30                   |        | 12,000                   | 2.51°              | 30.97  | 31.99           | 33.04           | 34.16           | No Interference |
| HTNRS 4030-083608 |                           |                  |                     | 36                   |        | 14,000                   | 2.14°              | 37.02  | 38.22           | 39.48           | 40.82           | No Interference |
| HTNRS 4030-084008 |                           |                  |                     | 40                   |        | 14,000                   | 1.96°              | 41.05  | 42.38           | 43.78           | No Interference | No Interference |
| HTNRS 4030-082018 |                           |                  |                     | 20                   |        | 12,000                   | 3.56°              | —  | 20.98           | 21.69           | 22.41           | 24.03           |
| HTNRS 4030-082518 |                           |                  | 25                  | 12,000               | 2.99°  | —                        | 26.02              | 26.89  | 27.79           | No Interference |                 |                 |
| HTNRS 4030-083018 |                           |                  | 30                  | 12,000               | 2.57°  | —                        | 31.06              | 32.09  | 33.18           | No Interference |                 |                 |
| HTNRS 4030-083518 |                           |                  | 35                  | 14,000               | 2.25°  | —                        | 36.10              | 37.29  | 38.56           | No Interference |                 |                 |
| HTNRS 4030-084018 |                           |                  | 40                  | 14,000               | 2.01°  | —                        | 41.13              | 42.49  | 43.94           | No Interference |                 |                 |
| HTNRS 4030-085018 |                           |                  | 50                  | 15,000               | 1.65°  | —                        | 51.18              | 52.87  | No Interference | No Interference |                 |                 |
| HTNRS 4030-086018 |                           |                  | 60                  | 16,000               | 1.40°  | —                        | 61.25              | No Interference                                      | No Interference | No Interference |                 |                 |
| HTNRS 4030-083028 |                           |                  | 30                  | B                    | 1.4°   | 12,000                   | 2.64°              | —  | —               | 31.14           | 32.19           | No Interference |
| HTNRS 4030-084028 |                           |                  | 40                  |                      |        | 14,000                   | 2.06°              | —  | —               | 41.21           | 42.61           | No Interference |
| HTNRS 4030-083038 |                           |                  | 30                  |                      | 1.9°   | 12,000                   | 2.71°              | —  | —               | —               | 31.21           | No Interference |
| HTNRS 4030-084038 |                           |                  | 40                  |                      |        | 14,000                   | 2.12°              | —  | —               | —               | 41.28           | No Interference |
| HTNRS 4030-083358 |                           |                  | 33                  |                      | C      | 2.9°                     | 16,500             | 2.64°  | —               | —               | —               | No Interference |
| HTNRS 4040-102508 |                           |                  | 25                  |                      | 4      | 0.4°                     | 12,000             | 2.12°  | 25.49           | 26.28           | 27.13           | 28.04           |
| HTNRS 4040-103008 | 30                        | 12,000           | 1.80°               | 30.52                |        |                          | 31.48              | 32.50  | No Interference | No Interference |                 |                 |
| HTNRS 4040-103508 | 35                        | 14,000           | 1.57°               | 35.55                |        |                          | 36.67              | 37.87  | No Interference | No Interference |                 |                 |
| HTNRS 4040-104008 | 40                        | 14,000           | 1.39°               | 40.58                |        |                          | 41.87              | No Interference                                      | No Interference | No Interference |                 |                 |
| HTNRS 4040-104508 | 45                        | 15,000           | 1.24°               | 45.61                |        |                          | 47.06              | No Interference                                      | No Interference | No Interference |                 |                 |
| HTNRS 4040-105008 | 50                        | 15,000           | 1.13°               | 50.63                |        |                          | 52.24              | No Interference                                      | No Interference | No Interference |                 |                 |
| HTNRS 4040-102018 | 20                        | A                | 0.9°                | 12,000               |        | 2.64°                    | —                  | 20.57  | 21.23           | 21.93           | No Interference |                 |
| HTNRS 4040-102518 | 25                        |                  |                     | 12,000               |        | 2.18°                    | —                  | 25.60  | 26.43           | 27.32           | No Interference |                 |
| HTNRS 4040-103018 | 30                        |                  |                     | 12,000               |        | 1.85°                    | —                  | 30.64  | 31.63           | No Interference | No Interference |                 |
| HTNRS 4040-103518 | 35                        |                  |                     | 14,000               |        | 1.61°                    | —                  | 35.67  | 36.83           | No Interference | No Interference |                 |
| HTNRS 4040-104018 | 40                        |                  |                     | 14,000               |        | 1.42°                    | —                  | 40.70  | No Interference | No Interference | No Interference |                 |
| HTNRS 4040-105018 | 50                        |                  |                     | 15,000               |        | 1.16°                    | —                  | 50.75  | No Interference | No Interference | No Interference |                 |
| HTNRS 4040-106018 | 60                        | 16,000           | 0.98°               | —                    |        | No Interference          | No Interference    | No Interference                                      | No Interference |                 |                 |                 |
| HTNRS 4040-104928 | 49                        | C                | 1.4°                | 15,000               |        | 1.21°                    | —                  | —  | No Interference | No Interference | No Interference |                 |
| HTNRS 4040-106028 | 60                        |                  |                     | 17,000               |        | 1.88°                    | —                  | —  | 60.94           | No Interference | No Interference |                 |
| HTNRS 4040-103038 | 30                        | B                | 1.9°                | 16,000               |        | 3.46°                    | —                  | —  | —               | 30.89           | 33.13           |                 |
| HTNRS 4040-106738 | 67                        |                  |                     | 23,000               |        | 1.75°                    | —                  | —  | —               | No Interference | No Interference |                 |
| HTNRS 4040-104558 | 45                        | C                | 2.9°                | 18,000               |        | 2.62°                    | —                  | —  | —               | —               | No Interference |                 |
| HTNRS 4060-152018 | 20                        | 6                | 0.9°                | 17,000               | 2.69°  | —                        | 20.63              | 21.28  | 21.97           | No Interference |                 |                 |
| HTNRS 4060-153018 | 30                        |                  |                     | A                    | 17,000 | 1.88°                    | —                  | 30.70  | 31.68           | No Interference | No Interference |                 |
| HTNRS 4060-154018 | 40                        |                  |                     |                      | 17,000 | 1.44°                    | —                  | 40.76  | No Interference | No Interference | No Interference |                 |
| HTNRS 4060-155018 | 50                        |                  |                     |                      | 17,000 | 1.17°                    | —                  | 50.83  | No Interference | No Interference | No Interference |                 |
| HTNRS 4060-156018 | 60                        |                  |                     |                      | 18,000 | 0.98°                    | —                  | No Interference                                      | No Interference | No Interference | No Interference |                 |
| HTNRS 4060-155128 | 51                        |                  |                     |                      | C      | 1.4°                     | 17,000             | 1.18°  | —               | —               | No Interference | No Interference |
| HTNRS 4060-153938 | 39                        |                  | 17,000              |                      |        | 1.55°                    | —                  | —  | —               | No Interference | No Interference |                 |
| HTNRS 4060-156938 | 69                        |                  | 23,500              | 1.71°                |        | —                        | —                  | —  | No Interference | No Interference |                 |                 |
| HTNRS 4060-154758 | 47                        |                  | 23,000              | 2.53°                |        | —                        | —                  | —  | —               | No Interference |                 |                 |

4 Flutes

$\phi 3\text{mm}$  Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Milling Conditions for HTNRS

| WORK MATERIAL |                       |                    |                     |                  | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKH<br>(55~65HRC) |                    |                                 |                                  |       |       |      |
|---------------|-----------------------|--------------------|---------------------|------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|-------|-------|------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Neck Taper Angle TN | Neck Length (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |       |       |      |
| 4010-020608   | 1                     | R0.2               | 0.4°                | 6                | 20,000  | 2,600              | 0.06                            | 0.44                             | 11,600                                     | 980                | 0.029                           | 0.23                             | 8,900                                      | 530                | 0.012                           | 0.09                             |       |       |      |
| 4010-021008   |                       |                    |                     | 10               | 19,000  | 2,450              | 0.03                            | 0.42                             | 11,000                                     | 920                | 0.015                           | 0.21                             | 8,500                                      | 480                | 0.008                           | 0.07                             |       |       |      |
| 4010-022008   |                       |                    |                     | 20               | 17,000  | 2,150              | 0.008                           | 0.37                             | 9,700                                      | 800                | 0.005                           | 0.18                             | 7,600                                      | 400                | 0.004                           | 0.05                             |       |       |      |
| 4010-023008   |                       |                    |                     | 30               | 12,000  | 1,500              | 0.003                           | 0.26                             | 7,200                                      | 570                | 0.002                           | 0.12                             | 6,000                                      | 310                | 0.002                           | 0.04                             |       |       |      |
| 4010-020618   |                       |                    | 0.9°                | 6                | 20,000  | 2,600              | 0.06                            | 0.45                             | 11,600                                     | 980                | 0.029                           | 0.24                             | 8,900                                      | 530                | 0.012                           | 0.1                              |       |       |      |
| 4010-021018   |                       |                    |                     | 10               | 19,000  | 2,450              | 0.03                            | 0.43                             | 11,000                                     | 920                | 0.015                           | 0.22                             | 8,500                                      | 480                | 0.008                           | 0.075                            |       |       |      |
| 4010-021518   |                       |                    |                     | 15               | 18,500  | 2,400              | 0.02                            | 0.41                             | 10,700                                     | 880                | 0.01                            | 0.21                             | 8,200                                      | 450                | 0.006                           | 0.065                            |       |       |      |
| 4010-022018   |                       |                    |                     | 20               | 18,000  | 2,300              | 0.01                            | 0.4                              | 10,400                                     | 850                | 0.006                           | 0.2                              | 8,000                                      | 430                | 0.005                           | 0.05                             |       |       |      |
| 4010-022518   |                       |                    |                     | 25               | 17,000  | 2,150              | 0.008                           | 0.38                             | 9,900                                      | 800                | 0.005                           | 0.19                             | 7,700                                      | 410                | 0.004                           | 0.05                             |       |       |      |
| 4010-023018   |                       |                    |                     | 30               | 16,000  | 2,000              | 0.007                           | 0.35                             | 9,400                                      | 750                | 0.004                           | 0.18                             | 7,400                                      | 390                | 0.004                           | 0.05                             |       |       |      |
| 4010-023518   |                       |                    |                     | 35               | 15,000  | 1,850              | 0.006                           | 0.32                             | 8,800                                      | 700                | 0.004                           | 0.16                             | 7,000                                      | 370                | 0.003                           | 0.05                             |       |       |      |
| 4010-024018   |                       |                    |                     | 40               | 14,000  | 1,750              | 0.005                           | 0.3                              | 8,300                                      | 660                | 0.003                           | 0.15                             | 6,700                                      | 350                | 0.003                           | 0.05                             |       |       |      |
| 4010-025018   |                       |                    |                     | 50               | 12,000  | 1,500              | 0.003                           | 0.28                             | 7,200                                      | 570                | 0.002                           | 0.14                             | 6,000                                      | 310                | 0.002                           | 0.05                             |       |       |      |
| 4010-020628   |                       |                    |                     | 1.4°             | 6   | 20,000             | 2,600                           | 0.06                             | 0.46                                       | 11,600             | 980                             | 0.029                            | 0.25                                       | 8,900              | 530                             | 0.012                            | 0.11  |       |      |
| 4010-021028   |                       |                    |                     |                  | 10  | 20,000             | 2,600                           | 0.04                             | 0.45                                       | 11,400             | 960                             | 0.02                             | 0.24                                       | 8,750              | 510                             | 0.01                             | 0.08  |       |      |
| 4010-022028   |                       |                    |                     |                  | 20  | 19,000             | 2,400                           | 0.02                             | 0.4  | 10,900             | 900                             | 0.01                             | 0.2  | 8,400              | 470                             | 0.005                            | 0.06  |       |      |
| 4010-023028   |                       |                    |                     |                  | 30  | 18,000             | 2,300                           | 0.01                             | 0.4  | 10,400             | 850                             | 0.006                            | 0.2  | 8,000              | 430                             | 0.005                            | 0.05  |       |      |
| 40125-020618  |                       |                    |                     | 1.25             | R0.2  | 0.9°               | 6                               | 16,000                           | 2,600                                      | 0.075              | 0.56                            | 9,200                            | 990  | 0.036              | 0.3                             | 7,100                            | 540   | 0.015 | 0.12 |
| 40125-021018  |                       |                    |                     |                  |   |                    | 10                              | 16,000                           | 2,600                                      | 0.057              | 0.55                            | 9,200                            | 990  | 0.027              | 0.29                            | 7,100                            | 540   | 0.012 | 0.1  |
| 40125-021518  |                       |                    |                     |                  |   |                    | 15                              | 15,500                           | 2,500                                      | 0.04               | 0.53                            | 8,900                            | 950  | 0.019              | 0.27                            | 6,900                            | 500   | 0.01  | 0.08 |
| 40125-022018  | 20                    | 15,000             | 2,400               |                  |   |                    | 0.022                           | 0.51                             | 8,700                                      | 900                | 0.011                           | 0.26                             | 6,700                                      | 470                | 0.007                           | 0.07                             |       |       |      |
| 40125-023018  | 30                    | 14,400             | 2,300               |                  |   | 0.011              | 0.47                            | 8,300                            | 860  | 0.006              | 0.23                            | 6,400                            | 440  | 0.005              | 0.06                            |                                  |       |       |      |
| 40125-024018  | 40                    | 12,800             | 2,000               |                  |   | 0.008              | 0.42                            | 7,500                            | 750  | 0.004              | 0.21                            | 5,900                            | 390  | 0.004              | 0.06                            |                                  |       |       |      |
| 40125-025018  | 50                    | 11,000             | 1,700               |                  |   | 0.006              | 0.37                            | 6,500                            | 650  | 0.003              | 0.19                            | 5,300                            | 350  | 0.003              | 0.06                            |                                  |       |       |      |
| 4015-030608   | 1.5                   | R0.3               | 0.4°                |                  |   | 6                  | 13,500                          | 2,600                            | 0.09                                       | 0.67               | 7,800                           | 990                              | 0.043                                      | 0.36               | 6,000                           | 540                              | 0.018 | 0.15  |      |
| 4015-031008   |                       |                    |                     | 10               | 13,500  | 2,600              | 0.083                           | 0.66                             | 7,700                                      | 980                | 0.04                            | 0.35                             | 6,000                                      | 540                | 0.017                           | 0.13                             |       |       |      |
| 4015-032008   |                       |                    |                     | 20               | 12,500  | 2,400              | 0.028                           | 0.61                             | 7,000                                      | 880                | 0.015                           | 0.31                             | 5,500                                      | 460                | 0.009                           | 0.09                             |       |       |      |
| 4015-033008   |                       |                    |                     | 30               | 12,000  | 2,300              | 0.012                           | 0.55                             | 6,900                                      | 860                | 0.007                           | 0.27                             | 5,350                                      | 440                | 0.006                           | 0.07                             |       |       |      |
| 4015-030618   |                       |                    | 0.9°                | 6                | 13,500  | 2,600              | 0.09                            | 0.67                             | 7,800                                      | 990                | 0.043                           | 0.36                             | 6,000                                      | 540                | 0.018                           | 0.15                             |       |       |      |
| 4015-031018   |                       |                    |                     | 10               | 13,500  | 2,600              | 0.083                           | 0.67                             | 7,800                                      | 990                | 0.04                            | 0.36                             | 6,000                                      | 540                | 0.017                           | 0.14                             |       |       |      |
| 4015-031518   |                       |                    |                     | 15               | 13,000  | 2,500              | 0.055                           | 0.65                             | 7,500                                      | 950                | 0.029                           | 0.34                             | 5,800                                      | 500                | 0.013                           | 0.12                             |       |       |      |
| 4015-032018   |                       |                    |                     | 20               | 12,500  | 2,400              | 0.035                           | 0.63                             | 7,200                                      | 900                | 0.018                           | 0.32                             | 5,600                                      | 470                | 0.01                            | 0.1                              |       |       |      |
| 4015-032518   |                       |                    | 25                  | 12,500           | 2,400   | 0.025              | 0.61                            | 7,000                            | 880  | 0.013              | 0.31                            | 5,500                            | 460  | 0.009              | 0.08                            |                                  |       |       |      |
| 4015-033018   |                       |                    | 30                  | 12,000           | 2,300   | 0.015              | 0.6                             | 6,900                            | 860  | 0.008              | 0.3                             | 5,350                            | 440  | 0.007              | 0.07                            |                                  |       |       |      |
| 4015-034018   |                       |                    | 40                  | 12,000           | 2,300   | 0.012              | 0.55                            | 6,900                            | 860  | 0.007              | 0.27                            | 5,350                            | 440  | 0.006              | 0.07                            |                                  |       |       |      |
| 4015-035018   |                       |                    | 50                  | 10,500           | 2,000   | 0.009              | 0.5                             | 6,100                            | 740  | 0.005              | 0.25                            | 4,850                            | 380  | 0.005              | 0.07                            |                                  |       |       |      |
| 4015-030628   |                       |                    | 1.4°                | 6                | 13,500  | 2,600              | 0.09                            | 0.67                             | 7,800                                      | 990                | 0.043                           | 0.36                             | 6,000                                      | 540                | 0.018                           | 0.15                             |       |       |      |
| 4015-031028   |                       |                    |                     | 10               | 13,500  | 2,600              | 0.085                           | 0.67                             | 7,800                                      | 990                | 0.04                            | 0.36                             | 6,000                                      | 540                | 0.017                           | 0.15                             |       |       |      |
| 4015-032028   |                       |                    |                     | 20               | 13,000  | 2,500              | 0.05                            | 0.63                             | 7,300                                      | 920                | 0.02                            | 0.33                             | 5,600                                      | 480                | 0.011                           | 0.11                             |       |       |      |
| 4015-033028   |                       |                    |                     | 30               | 12,500  | 2,400              | 0.025                           | 0.61                             | 7,000                                      | 880                | 0.013                           | 0.31                             | 5,500                                      | 460                | 0.009                           | 0.08                             |       |       |      |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



# Milling Conditions for HTNRS

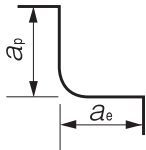
| WORK MATERIAL |                       |                    |                     | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                                    |                    |                                 | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                                    |                    |                                 | HARDENED STEELS<br>SKD / SKH<br>(55~65HRC) |                                    |                    |                                 |                                  |       |       |
|---------------|-----------------------|--------------------|---------------------|---|------------------------------------|--------------------|---------------------------------|--|------------------------------------|--------------------|---------------------------------|--|------------------------------------|--------------------|---------------------------------|----------------------------------|-------|-------|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Neck Taper Angle TN | Neck Length (mm)  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm)           | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm)           | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |       |       |
| 40175-030618  | 1.75                  | R0.3               | 0.9°                | 6   | 11,500                             | 2,600              | 0.105                           | 0.78                                       | 6,600                              | 990                | 0.05                            | 0.42                                       | 5,100                              | 540                | 0.021                           | 0.17                             |       |       |
| 40175-031018  |                       |                    |                     | 10  | 11,500                             | 2,600              | 0.105                           | 0.78                                       | 6,600                              | 990                | 0.05                            | 0.42                                       | 5,100                              | 540                | 0.021                           | 0.17                             |       |       |
| 40175-031518  |                       |                    |                     | 15  | 11,500                             | 2,600              | 0.07                            | 0.76                                       | 6,500                              | 950                | 0.037                           | 0.4  | 5,000                              | 510                | 0.017                           | 0.14                             |       |       |
| 40175-032018  |                       |                    |                     | 20  | 11,000                             | 2,450              | 0.047                           | 0.74                                       | 6,400                              | 920                | 0.024                           | 0.38                                       | 4,900                              | 480                | 0.013                           | 0.12                             |       |       |
| 40175-033018  |                       |                    |                     | 30  | 11,000                             | 2,450              | 0.027                           | 0.71                                       | 6,400                              | 920                | 0.014                           | 0.36                                       | 4,900                              | 480                | 0.01                            | 0.1                              |       |       |
| 40175-034018  |                       |                    |                     | 40  | 10,000                             | 2,200              | 0.016                           | 0.67                                       | 5,800                              | 820                | 0.009                           | 0.33                                       | 4,450                              | 420                | 0.008                           | 0.08                             |       |       |
| 40175-035018  |                       |                    |                     | 50  | 10,000                             | 2,200              | 0.013                           | 0.62                                       | 5,800                              | 820                | 0.008                           | 0.31                                       | 4,450                              | 420                | 0.007                           | 0.08                             |       |       |
| 4020-052008   |                       |                    |                     | 2   | R0.5                               | 0.4°               | 20                              | 9,500                                      | 2,450                              | 0.06               | 0.85                            | 5,500                                      | 920                                | 0.025              | 0.43                            | 4,250                            | 480   | 0.015 |
| 4020-052608   | 26                    | 9,500              | 2,450               |   |                                    |                    | 0.04                            | 0.83                                       | 5,500                              | 920                | 0.021                           | 0.42                                       | 4,250                              | 480                | 0.013                           | 0.12                             |       |       |
| 4020-053008   | 30                    | 9,000              | 2,300               |   |                                    |                    | 0.03                            | 0.79                                       | 5,400                              | 880                | 0.016                           | 0.41                                       | 4,100                              | 450                | 0.012                           | 0.11                             |       |       |
| 4020-053608   | 36                    | 9,000              | 2,300               |   |                                    |                    | 0.02                            | 0.75                                       | 5,200                              | 850                | 0.011                           | 0.39                                       | 4,000                              | 430                | 0.01                            | 0.1                              |       |       |
| 4020-054008   | 40                    | 9,000              | 2,300               |   |                                    |                    | 0.02                            | 0.7  | 5,200                              | 850                | 0.01                            | 0.38                                       | 4,000                              | 430                | 0.009                           | 0.1                              |       |       |
| 4020-051018   | 0.9°                  | 10                 | 10,000              |   |                                    |                    | 2,600                           | 0.12                                       | 0.9                                | 5,800              | 990                             | 0.057                                      | 0.49                               | 4,450              | 540                             | 0.024                            | 0.2   |       |
| 4020-051518   |                       | 15                 | 10,000              |   |                                    |                    | 2,600                           | 0.09                                       | 0.88                               | 5,600              | 950                             | 0.044                                      | 0.47                               | 4,350              | 510                             | 0.02                             | 0.17  |       |
| 4020-052018   |                       | 20                 | 9,500               |   |                                    |                    | 2,450                           | 0.06                                       | 0.86                               | 5,500              | 920                             | 0.03                                       | 0.45                               | 4,250              | 480                             | 0.016                            | 0.15  |       |
| 4020-052518   |                       | 25                 | 9,500               |   |                                    |                    | 2,450                           | 0.05                                       | 0.85                               | 5,500              | 920                             | 0.025                                      | 0.43                               | 4,250              | 480                             | 0.015                            | 0.13  |       |
| 4020-053018   |                       | 30                 | 9,500               |   |                                    |                    | 2,450                           | 0.04                                       | 0.83                               | 5,500              | 920                             | 0.021                                      | 0.42                               | 4,250              | 480                             | 0.013                            | 0.12  |       |
| 4020-053518   |                       | 35                 | 9,000               |   |                                    | 2,300              | 0.03                            | 0.81                                       | 5,300                              | 880                | 0.016                           | 0.41                                       | 4,100                              | 450                | 0.012                           | 0.11                             |       |       |
| 4020-054018   |                       | 40                 | 9,000               |   |                                    | 2,300              | 0.02                            | 0.8  | 5,200                              | 850                | 0.012                           | 0.4  | 4,000                              | 430                | 0.01                            | 0.1                              |       |       |
| 4020-054518   |                       | 45                 | 9,000               |   |                                    | 2,300              | 0.02                            | 0.75                                       | 5,200                              | 850                | 0.011                           | 0.39                                       | 4,000                              | 430                | 0.01                            | 0.1                              |       |       |
| 4020-055018   |                       | 50                 | 9,000               |   |                                    | 2,300              | 0.017                           | 0.75                                       | 5,200                              | 850                | 0.01                            | 0.38                                       | 4,000                              | 430                | 0.009                           | 0.1                              |       |       |
| 4020-053028   |                       | 1.4°               | 30                  |   |                                    | 9,500              | 2,450                           | 0.05                                       | 0.85                               | 5,500              | 920                             | 0.025                                      | 0.43                               | 4,250              | 480                             | 0.015                            | 0.13  |       |
| 4020-054028   | 40                    |                    | 9,500               |   |                                    | 2,450              | 0.04                            | 0.83                                       | 5,500                              | 920                | 0.02                            | 0.42                                       | 4,250                              | 480                | 0.013                           | 0.12                             |       |       |
| 4020-053038   | 1.9°                  | 30                 | 9,500               |   |                                    | 2,450              | 0.06                            | 0.85                                       | 5,500                              | 920                | 0.03                            | 0.43                                       | 4,250                              | 480                | 0.017                           | 0.14                             |       |       |
| 4020-054038   |                       | 40                 | 9,500               |   |                                    | 2,450              | 0.05                            | 0.85                                       | 5,500                              | 920                | 0.025                           | 0.43                                       | 4,250                              | 480                | 0.015                           | 0.13                             |       |       |
| 4020-053058   | 2.9°                  | 30                 | 9,500               |   |                                    | 2,450              | 0.07                            | 0.85                                       | 5,500                              | 920                | 0.035                           | 0.45                                       | 4,250                              | 480                | 0.017                           | 0.16                             |       |       |
| 4020-054258   |                       | 42                 | 9,500               |   |                                    | 2,450              | 0.06                            | 0.85                                       | 5,500                              | 920                | 0.03                            | 0.45                                       | 4,250                              | 480                | 0.016                           | 0.15                             |       |       |
| 4030-082008   | 3                     | R0.8               | 0.4°                |   |                                    | 20                 | 6,500                           | 2,500                                      | 0.12                               | 1.06               | 3,900                           | 960  | 0.05                               | 0.58               | 3,200                           | 550                              | 0.029 | 0.25  |
| 4030-082608   |                       |                    |                     |   |                                    | 26                 | 6,300                           | 2,400                                      | 0.08                               | 1.04               | 3,800                           | 940  | 0.038                              | 0.56               | 3,100                           | 520                              | 0.025 | 0.22  |
| 4030-083008   |                       |                    |                     |   |                                    | 30                 | 6,300                           | 2,400                                      | 0.064                              | 1.01               | 3,800                           | 920  | 0.034                              | 0.55               | 3,100                           | 510                              | 0.022 | 0.21  |
| 4030-083608   |                       |                    |                     |   |                                    | 36                 | 6,300                           | 2,400                                      | 0.05                               | 1                  | 3,800                           | 920  | 0.028                              | 0.52               | 3,100                           | 510                              | 0.02  | 0.19  |
| 4030-084008   |                       |                    |                     |   |                                    | 40                 | 6,300                           | 2,400                                      | 0.04                               | 0.98               | 3,800                           | 920  | 0.023                              | 0.51               | 3,100                           | 510                              | 0.018 | 0.17  |
| 4030-082018   |                       |                    |                     |   |                                    | 0.9°               | 20                              | 6,700                                      | 2,600                              | 0.13               | 1.07                            | 4,000                                      | 1,000                              | 0.065              | 0.6                             | 3,300                            | 590   | 0.034 |
| 4030-082518   |                       |                    |                     | 25  | 6,500                              |                    | 2,500                           | 0.1  | 1.05                               | 3,900              | 960                             | 0.05                                       | 0.58                               | 3,200              | 550                             | 0.029                            | 0.25  |       |
| 4030-083018   |                       |                    |                     | 30  | 6,300                              |                    | 2,400                           | 0.072                                      | 1.03                               | 3,800              | 920                             | 0.038                                      | 0.56                               | 3,100              | 510                             | 0.024                            | 0.22  |       |
| 4030-083518   |                       |                    | 35                  | 6,300   | 2,400                              |                    | 0.064                           | 1.01                                       | 3,800                              | 920                | 0.034                           | 0.55                                       | 3,100                              | 510                | 0.022                           | 0.21                             |       |       |
| 4030-084018   |                       |                    | 1.4°                | 40  | 6,300                              | 2,400              | 0.056                           | 1  | 3,800                              | 920                | 0.03                            | 0.54                                       | 3,100                              | 510                | 0.021                           | 0.2                              |       |       |
| 4030-085018   |                       |                    |                     | 50  | 6,300                              | 2,400              | 0.04                            | 0.98                                       | 3,800                              | 920                | 0.023                           | 0.51                                       | 3,100                              | 510                | 0.018                           | 0.17                             |       |       |
| 4030-086018   |                       |                    |                     | 60  | 6,000                              | 2,300              | 0.024                           | 0.96                                       | 3,600                              | 870                | 0.015                           | 0.49                                       | 2,900                              | 470                | 0.015                           | 0.15                             |       |       |
| 4030-083028   |                       |                    |                     | 30  | 6,500                              | 2,500              | 0.09                            | 1.03                                       | 3,900                              | 960                | 0.045                           | 0.57                                       | 3,200                              | 550                | 0.03                            | 0.24                             |       |       |
| 4030-084028   |                       |                    |                     | 40  | 6,300                              | 2,400              | 0.06                            | 1.01                                       | 3,800                              | 920                | 0.035                           | 0.55                                       | 3,100                              | 510                | 0.02                            | 0.21                             |       |       |
| 4030-083038   |                       |                    |                     | 1.9°  | 30                                 | 6,500              | 2,500                           | 0.1  | 1.05                               | 3,900              | 960                             | 0.05                                       | 0.58                               | 3,200              | 550                             | 0.03                             | 0.25  |       |
| 4030-084038   |                       |                    | 40                  |   | 6,300                              | 2,400              | 0.07                            | 1.03                                       | 3,800                              | 920                | 0.04                            | 0.56                                       | 3,100                              | 510                | 0.025                           | 0.22                             |       |       |
| 4030-083358   |                       |                    | 2.9°                | 33  | 6,700                              | 2,500              | 0.12                            | 1.07                                       | 3,900                              | 1,000              | 0.06                            | 0.6  | 3,200                              | 590                | 0.03                            | 0.28                             |       |       |

4 Flutes

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Square
- Long Neck Square
- Radius
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

| WORK MATERIAL |                       |                    |                     |                  | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKH<br>(55~65HRC) |                    |                                 |                                  |       |      |       |     |
|---------------|-----------------------|--------------------|---------------------|------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|-------|------|-------|-----|
| Model Number  | Outside Diameter (mm) | Corner Radius (mm) | Neck Taper Angle TN | Neck Length (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |       |      |       |     |
| 4040-102508   | 4                     | R1                 | 0.4°                | 25               | 5,000   | 2,600              | 0.17                            | 1.42                             | 3,000                                      | 1,000              | 0.085                           | 0.8                              | 2,450                                      | 600                | 0.045                           | 0.38                             |       |      |       |     |
| 4040-103008   |                       |                    |                     | 30               | 5,000   | 2,600              | 0.13                            | 1.39                             | 2,900                                      | 960                | 0.065                           | 0.77                             | 2,400                                      | 540                | 0.038                           | 0.34                             |       |      |       |     |
| 4040-103508   |                       |                    |                     | 35               | 4,800   | 2,450              | 0.09                            | 1.37                             | 2,900                                      | 920                | 0.048                           | 0.75                             | 2,350                                      | 480                | 0.032                           | 0.3                              |       |      |       |     |
| 4040-104008   |                       |                    |                     | 40               | 4,800   | 2,450              | 0.08                            | 1.35                             | 2,900                                      | 920                | 0.043                           | 0.74                             | 2,350                                      | 480                | 0.03                            | 0.28                             |       |      |       |     |
| 4040-104508   |                       |                    |                     | 45               | 4,800   | 2,450              | 0.07                            | 1.33                             | 2,900                                      | 920                | 0.038                           | 0.72                             | 2,350                                      | 480                | 0.028                           | 0.26                             |       |      |       |     |
| 4040-105008   |                       |                    |                     | 50               | 4,800   | 2,450              | 0.06                            | 1.32                             | 2,900                                      | 920                | 0.034                           | 0.7                              | 2,350                                      | 480                | 0.026                           | 0.25                             |       |      |       |     |
| 4040-102018   |                       |                    | 4                   | R1               | 0.9°  | 20                 | 5,000                           | 2,600                            | 0.19                                       | 1.44               | 3,000                           | 1,000                            | 0.095                                      | 0.82               | 2,450                           | 600                              | 0.048 | 0.4  |       |     |
| 4040-102518   |                       |                    |                     |                  |   | 25                 | 5,000                           | 2,600                            | 0.17                                       | 1.42               | 3,000                           | 1,000                            | 0.085                                      | 0.8                | 2,450                           | 600                              | 0.045 | 0.38 |       |     |
| 4040-103018   |                       |                    |                     |                  |   | 30                 | 5,000                           | 2,600                            | 0.15                                       | 1.41               | 3,000                           | 1,000                            | 0.076                                      | 0.79               | 2,450                           | 600                              | 0.042 | 0.36 |       |     |
| 4040-103518   |                       |                    |                     |                  |   | 35                 | 4,800                           | 2,450                            | 0.12                                       | 1.39               | 2,900                           | 960                              | 0.062                                      | 0.77               | 2,400                           | 540                              | 0.037 | 0.33 |       |     |
| 4040-104018   |                       |                    |                     |                  |   | 40                 | 4,800                           | 2,450                            | 0.09                                       | 1.37               | 2,900                           | 920                              | 0.048                                      | 0.75               | 2,350                           | 480                              | 0.032 | 0.3  |       |     |
| 4040-105018   |                       |                    |                     |                  |   | 50                 | 4,800                           | 2,450                            | 0.08                                       | 1.35               | 2,900                           | 920                              | 0.043                                      | 0.72               | 2,350                           | 480                              | 0.029 | 0.27 |       |     |
| 4040-106018   |                       |                    |                     |                  | 1.4°  | 60                 | 4,800                           | 2,450                            | 0.06                                       | 1.32               | 2,900                           | 920                              | 0.034                                      | 0.7                | 2,350                           | 480                              | 0.026 | 0.25 |       |     |
| 4040-104928   |                       |                    |                     |                  |   | 49                 | 4,800                           | 2,500                            | 0.1  | 1.37               | 2,900                           | 960                              | 0.05                                       | 0.74               | 2,350                           | 540                              | 0.035 | 0.28 |       |     |
| 4040-106028   |                       |                    |                     |                  | 60  | 4,800              | 2,500                           | 0.08                             | 1.35                                       | 2,900              | 960                             | 0.04                             | 0.72                                       | 2,350              | 540                             | 0.03                             | 0.27  |      |       |     |
| 4040-103038   |                       |                    |                     |                  | 1.9°  | 30                 | 5,000                           | 2,600                            | 0.15                                       | 1.42               | 3,000                           | 1,000                            | 0.08                                       | 0.8                | 2,450                           | 600                              | 0.045 | 0.38 |       |     |
| 4040-106738   |                       |                    |                     |                  |   | 67                 | 4,800                           | 2,500                            | 0.12                                       | 1.4                | 2,900                           | 960                              | 0.05                                       | 0.78               | 2,350                           | 540                              | 0.03  | 0.35 |       |     |
| 4040-104558   |                       |                    |                     |                  | 45  | 5,000              | 2,600                           | 0.15                             | 1.41                                       | 3,000              | 1,000                           | 0.08                             | 0.79                                       | 2,450              | 600                             | 0.045                            | 0.36  |      |       |     |
| 4060-152018   |                       |                    |                     |                  | 6   | R1.5               | 0.9°                            | 20                               | 3,350                                      | 2,600              | 0.28                            | 2.16                             | 2,000                                      | 1,000              | 0.14                            | 1.24                             | 1,650 | 600  | 0.072 | 0.6 |
| 4060-153018   |                       |                    |                     |                  |   |                    |                                 | 30                               | 3,350                                      | 2,600              | 0.28                            | 2.16                             | 2,000                                      | 1,000              | 0.14                            | 1.24                             | 1,650 | 600  | 0.072 | 0.6 |
| 4060-154018   | 40                    | 3,350              | 2,600               | 0.26             |   |                    |                                 | 2.14                             | 2,000                                      | 1,000              | 0.131                           | 1.21                             | 1,650                                      | 600                | 0.068                           | 0.57                             |       |      |       |     |
| 4060-155018   | 50                    | 3,350              | 2,600               | 0.2              |   |                    |                                 | 2.1                              | 2,000                                      | 1,000              | 0.103                           | 1.17                             | 1,650                                      | 600                | 0.058                           | 0.51                             |       |      |       |     |
| 4060-156018   | 60                    | 3,150              | 2,400               | 0.14             |   |                    |                                 | 2.06                             | 1,900                                      | 920                | 0.075                           | 1.12                             | 1,550                                      | 510                | 0.048                           | 0.45                             |       |      |       |     |
| 4060-155128   | 1.4°                  | 51                 | 3,350               | 2,600            |   |                    | 0.2                             | 2.1                              | 2,000                                      | 1,000              | 0.1                             | 1.17                             | 1,650                                      | 600                | 0.058                           | 0.51                             |       |      |       |     |
| 4060-153938   |                       | 39                 | 3,350               | 2,600            |   |                    | 0.26                            | 2.14                             | 2,000                                      | 1,000              | 0.13                            | 1.21                             | 1,650                                      | 600                | 0.068                           | 0.57                             |       |      |       |     |
| 4060-156938   | 1.9°                  | 69                 | 3,150               | 2,400            |   |                    | 0.14                            | 2.06                             | 1,900                                      | 920                | 0.075                           | 1.12                             | 1,550                                      | 510                | 0.048                           | 0.45                             |       |      |       |     |
| 4060-154758   |                       | 47                 | 3,350               | 2,600            |   |                    | 0.26                            | 2.14                             | 2,000                                      | 1,000              | 0.13                            | 1.21                             | 1,650                                      | 600                | 0.068                           | 0.57                             |       |      |       |     |

### Side Milling



### Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Every coolant offers stable milling.

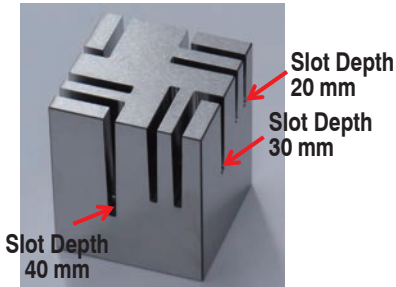


## Milling Example of Taper Slotting

HTNRS  $\phi 2 \times CR0.5 \times$  Neck Length 20 · 30 · 40

SKD61 (45HRC)

4 Flutes



- Work Size : 50 × 50 × 60 mm
- Inclined Angle : 1°
- Slot Length : 27 mm (L Shape Slot)  
21 mm (Straight Slot)
- Slot Width : 2.6 mm (Bottom)
- Slot Depth : 20, 30, 40 mm
- Coolant : Water Soluble

### ① Performance compared with straight neck type...Depth 20 mm L shape slotting

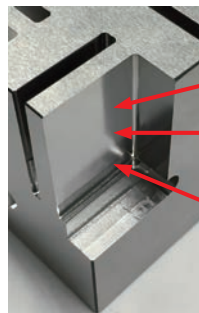
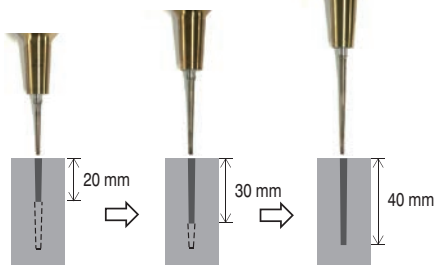
| Milling Process | Tool              | Neck Shape Helix Angle             | Tool Size (mm)                                      | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | Cycle Time       |
|-----------------|-------------------|------------------------------------|---|------------------------------------|--------------------|------------|------------------|
| Roughing        | HTNRS 4020-052018 | Taper Neck 0.9°<br>45° Helix Angle | $\phi 2 \times CR0.5 \times$<br>Neck Length 20      | 9,500                              | 2,450              | 0.064      | 20 min 18 sec    |
| Roughing        | HLRS 4020-05-200  | Straight Neck<br>30° Helix Angle   | $\phi 2 \times CR0.5 \times$<br>Effective Length 20 | 7,000                              | 800                | 0.025      | 1 h 30 min 9 sec |

**Taper neck is 7 times more efficient in 20 mm depth slotting !**

### ② Depth 40 mm L shape slotting

| Milling Process | Tool              | Neck Shape Helix Angle             | Tool Size (mm)                                    | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm)              | Cycle Time        |
|-----------------|-------------------|------------------------------------|---|------------------------------------|--------------------|-------------------------|-------------------|
| Roughing        | HTNRS 4020-052018 | Taper Neck 0.9°<br>45° Helix Angle | $\phi 2 \times CR0.5 \times$<br>Neck Length 20 mm | 9,500                              | 2,450              | 0.064                   | 27 min 8 sec      |
| Roughing        | HTNRS 4020-053018 |                                    | $\phi 2 \times CR0.5 \times$<br>Neck Length 30 mm | 9,500                              | 2,450              | 0.047                   | 15 min 32 sec     |
| Roughing        | HTNRS 4020-054018 |                                    | $\phi 2 \times CR0.5 \times$<br>Neck Length 40 mm | 9,000                              | 2,300              | 0.02                    | 40 min 26 sec     |
| Finishing       |                   |                                    |   | 4,500                              | 500                | 0.0001<br>(Cusp Height) | 4 h 28 min 50 sec |

#### Slotting image of depth 40 mm



Depth 20 mm  
Ra : 0.287  $\mu$ m

Depth 30 mm  
Ra : 0.241  $\mu$ m

Depth 40 mm  
Ra : 0.274  $\mu$ m

**40 mm slot depth roughing process completed in 1h 23 min ! Excellent surface finishing !**

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.05~R3

**HGB**



R0.05~R0.075 R0.1~R2 R2.5~R3

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 | ○                                | ●               | ●      | ●      | ★      | ★      |           |                 |          |        |          |                       |                 |                       |                  |                                       |

**Features**

Newly developed "HMGCOAT", carbide grade and tool shape offer higher wear/chipping resistance as compared to conventional tools.

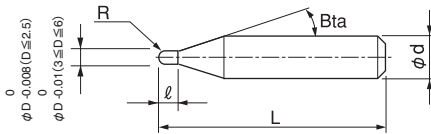
Achieves longer tool life and highly precise milling on hard materials.

High Precision Diameter Tolerance / Radius Accuracy / Shank Diameter Tolerance

| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy | Shank Diameter Tolerance |
|---------------------|--------------------|----------------------|--------------------------|
| R0.05 ~ R0.075      | <b>0/-0.008</b>    | <b>±0.002</b>        | <b>0/-0.004 (h4)</b>     |
| R0.1 ~ R1.25        |                    | <b>±0.003</b>        |                          |
| R1.5 ~ R2           | <b>0/-0.01</b>     | ±0.005               |                          |
| R2.5 ~ R3           |                    |                      |                          |

**Shank diameter tolerance h4!**

The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



Ball series for Steels

(★ Highly Recommended ● Recommended ○ Suggested)

| Number of Flutes | Model Number | Features                                   | Ball tip design | Copper | Carbon Steels | Pre hardened Steels | HARDENED STEELS |         |         |         |         | Alloy Steels | Aluminum Alloys | Plastics | Titanium/Heat Resistant Alloys | Page       |            |
|------------------|--------------|--|-----------------|--------|---------------|---------------------|-----------------|---------|---------|---------|---------|--------------|-----------------|----------|--------------------------------|------------|------------|
|                  |              |  |                 |        |               |                     | ~50 HRC         | ~55 HRC | ~60 HRC | ~65 HRC | ~70 HRC |              |                 |          |                                |            |            |
| 2 Flutes         | HGB          | Best suited for Hard Materials             | Super Negative  |        |               | ○                   | ●               | ●       | ●       | ★       | ★       |              |                 |          |                                | 422        |            |
|                  | HSB<br>HSB-S | For Hard Materials                         | Negative        |        | ○             | ○                   | ●               | ●       | ●       | ○       |         | ○            |                 |          |                                | ○          | 424<br>428 |
|                  |              |  |                 |        |               |                     |                 |         |         |         |         |              |                 |          |                                | ○          |            |
|                  | HBL          | Multi-purpose                              | Positive        |        | ●             | ○                   | ●               | ●       | ○       |         |         | ○            |                 |          |                                |            | 430        |
|                  | CSEB         | Multi-purpose<br>Excellent surface quality | Standard        |        | ●             | ●                   | ●               | ●       | ○       |         |         | ●            | ●               |          |                                | ○          | 432        |
| 3 Flutes         | CFB          | Multi-purpose<br>Excellent surface quality | Positive        |        | ●             | ●                   | ●               | ●       |         |         | ●       | ●            | ○               | ●        |                                | 442        |            |
| 4 Flutes         | HFB<br>HFB-S | For Hard Materials                         | Negative        |        |               |                     | ●               | ●       | ●       | ●       |         |              |                 |          |                                | 452<br>453 |            |
|                  |              |  |                 |        |               |                     |                 |         |         |         |         |              |                 |          |                                |            |            |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

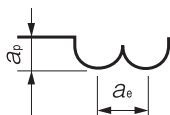
Total 20 models

Unit (mm)

| Model Number   | Radius of Ball Nose R | Length of Cut $l$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-----------------------|-------------------|---------------------------|------------------|-------------------------|--------------------------|
| HGB 2001-0010  | R0.05                 | 0.1               | 16°                       | 50               | 4                       | 12,960                   |
| HGB 20015-0015 | R0.075                | 0.15              | 16°                       | 50               | 4                       | 12,600                   |
| HGB 2002-0030  | R0.1                  | 0.3               | 16°                       | 50               | 4                       | 9,120                    |
| HGB 2003-0030  | R0.15                 | 0.3               | 16°                       | 50               | 4                       | 7,440                    |
| HGB 2003-0045  |                       | 0.45              |                           | 50               | 4                       | 7,440                    |
| HGB 2004-0040  | R0.2                  | 0.4               | 16°                       | 50               | 4                       | 5,040                    |
| HGB 2004-0060  |                       | 0.6               |                           | 50               | 4                       | 5,040                    |
| HGB 2005-0050  | R0.25                 | 0.5               | 16°                       | 50               | 4                       | 4,680                    |
| HGB 2005-0075  |                       | 0.75              |                           | 50               | 4                       | 4,680                    |
| HGB 2006-0060  | R0.3                  | 0.6               | 16°                       | 50               | 4                       | 4,560                    |
| HGB 2006-0090  |                       | 0.9               |                           | 50               | 4                       | 4,560                    |
| HGB 2008-0120  | R0.4                  | 1.2               | 16°                       | 50               | 4                       | 4,560                    |
| HGB 2010-0150  | R0.5                  | 1.5               | 16°                       | 50               | 4                       | 4,150                    |
| HGB 2015-0225  | R0.75                 | 2.25              | 16°                       | 50               | 4                       | 5,040                    |
| HGB 2020-0300  | R1                    | 3                 | 16°                       | 50               | 4                       | 3,720                    |
| HGB 2025-0375  | R1.25                 | 3.75              | 16°                       | 50               | 4                       | 6,370                    |
| HGB 2030-0450  | R1.5                  | 4.5               | 16°                       | 50               | 6                       | 4,560                    |
| HGB 2040-0600  | R2                    | 6                 | 16°                       | 50               | 6                       | 5,160                    |
| HGB 2050-0750  | R2.5                  | 7.5               | 16°                       | 50               | 6                       | 6,240                    |
| HGB 2060-0900  | R3                    | 9                 | —                         | 50               | 6                       | 6,480                    |

## Milling Conditions for HGB

| WORK MATERIAL |                          |                    | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX<br>(~55HRC) |                    |                        |                         | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                        |                         | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                        |                         | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                        |                         |
|---------------|--------------------------|--------------------|---|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|
| Model Number  | Radius of Ball Nose (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                                | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2001-0010     | R0.05                    | 0.1                | 48,000  | 200                | 0.005                  | 0.01                    | 48,000                                 | 200                | 0.005                  | 0.01                    | 48,000                                 | 150                | 0.003                  | 0.006                   | 40,000                                 | 120                | 0.002                  | 0.004                   |
| 20015-0015    | R0.075                   | 0.15               | 48,000  | 230                | 0.007                  | 0.014                   | 48,000                                 | 230                | 0.007                  | 0.014                   | 48,000                                 | 170                | 0.005                  | 0.01                    | 40,000                                 | 135                | 0.003                  | 0.006                   |
| 2002-0030     | R0.1                     | 0.3                | 44,000  | 250                | 0.01                   | 0.03                    | 42,000                                 | 250                | 0.01                   | 0.03                    | 40,000                                 | 200                | 0.008                  | 0.024                   | 36,000                                 | 150                | 0.006                  | 0.018                   |
| 2003-0030     | R0.15                    | 0.3                | 44,000  | 400                | 0.01                   | 0.03                    | 42,000                                 | 350                | 0.01                   | 0.03                    | 40,000                                 | 300                | 0.01                   | 0.03                    | 36,000                                 | 250                | 0.008                  | 0.024                   |
| 2003-0045     |                          | 0.45               | 44,000  | 400                | 0.01                   | 0.03                    | 42,000                                 | 350                | 0.01                   | 0.03                    | 40,000                                 | 300                | 0.01                   | 0.03                    | 36,000                                 | 250                | 0.008                  | 0.024                   |
| 2004-0040     | R0.2                     | 0.4                | 44,000  | 600                | 0.015                  | 0.045                   | 42,000                                 | 550                | 0.015                  | 0.045                   | 40,000                                 | 500                | 0.013                  | 0.036                   | 36,000                                 | 350                | 0.01                   | 0.027                   |
| 2004-0060     |                          | 0.6                | 44,000  | 600                | 0.015                  | 0.045                   | 42,000                                 | 550                | 0.015                  | 0.045                   | 40,000                                 | 500                | 0.013                  | 0.036                   | 36,000                                 | 350                | 0.01                   | 0.027                   |
| 2005-0050     | R0.25                    | 0.5                | 44,000  | 900                | 0.02                   | 0.065                   | 40,000                                 | 800                | 0.015                  | 0.05                    | 36,000                                 | 600                | 0.015                  | 0.05                    | 30,000                                 | 400                | 0.015                  | 0.03                    |
| 2005-0075     |                          | 0.75               | 44,000  | 900                | 0.02                   | 0.065                   | 40,000                                 | 800                | 0.015                  | 0.05                    | 36,000                                 | 600                | 0.015                  | 0.05                    | 30,000                                 | 400                | 0.015                  | 0.03                    |
| 2006-0060     | R0.3                     | 0.6                | 40,000  | 1,400              | 0.045                  | 0.15                    | 36,000                                 | 1,200              | 0.025                  | 0.13                    | 32,000                                 | 1,000              | 0.02                   | 0.1                     | 25,000                                 | 600                | 0.02                   | 0.1                     |
| 2006-0090     |                          | 0.9                | 40,000  | 1,400              | 0.045                  | 0.15                    | 36,000                                 | 1,200              | 0.025                  | 0.13                    | 32,000                                 | 1,000              | 0.02                   | 0.1                     | 25,000                                 | 600                | 0.02                   | 0.1                     |
| 2008-0120     | R0.4                     | 1.2                | 35,000  | 1,600              | 0.06                   | 0.21                    | 30,000                                 | 1,600              | 0.04                   | 0.17                    | 26,000                                 | 1,350              | 0.04                   | 0.15                    | 20,000                                 | 700                | 0.02                   | 0.12                    |
| 2010-0150     | R0.5                     | 1.5                | 30,000  | 1,750              | 0.2                    | 0.4                     | 24,000                                 | 2,000              | 0.1                    | 0.3                     | 21,000                                 | 1,750              | 0.05                   | 0.2                     | 16,000                                 | 875                | 0.05                   | 0.2                     |
| 2015-0225     | R0.75                    | 2.25               | 30,000  | 2,450              | 0.25                   | 0.55                    | 17,000                                 | 2,000              | 0.12                   | 0.4                     | 15,000                                 | 1,750              | 0.06                   | 0.29                    | 11,250                                 | 875                | 0.06                   | 0.29                    |
| 2020-0300     | R1                       | 3                  | 28,000  | 2,900              | 0.3                    | 0.7                     | 14,000                                 | 2,100              | 0.15                   | 0.5                     | 14,700                                 | 2,160              | 0.1                    | 0.35                    | 11,040                                 | 1,080              | 0.08                   | 0.35                    |
| 2025-0375     | R1.25                    | 3.75               | 24,500  | 2,950              | 0.35                   | 0.85                    | 12,250                                 | 2,150              | 0.17                   | 0.6                     | 12,840                                 | 2,220              | 0.12                   | 0.45                    | 9,660                                  | 1,110              | 0.1                    | 0.45                    |
| 2030-0450     | R1.5                     | 4.5                | 21,000  | 3,000              | 0.4                    | 1                       | 10,500                                 | 2,200              | 0.2                    | 0.7                     | 11,040                                 | 2,280              | 0.15                   | 0.55                    | 8,280                                  | 1,140              | 0.12                   | 0.55                    |
| 2040-0600     | R2                       | 6                  | 18,000  | 3,200              | 0.5                    | 1.3                     | 9,000                                  | 2,300              | 0.25                   | 0.95                    | 9,480                                  | 2,400              | 0.18                   | 0.75                    | 7,080                                  | 1,200              | 0.15                   | 0.75                    |
| 2050-0750     | R2.5                     | 7.5                | 15,600  | 3,500              | 0.5                    | 1.5                     | 7,800                                  | 2,500              | 0.25                   | 1.05                    | 8,160                                  | 2,520              | 0.2                    | 0.85                    | 6,120                                  | 1,260              | 0.15                   | 0.85                    |
| 2060-0900     | R3                       | 9                  | 13,000  | 3,500              | 0.6                    | 1.8                     | 6,500                                  | 2,500              | 0.3                    | 1.3                     | 6,840                                  | 2,640              | 0.25                   | 1                       | 5,000                                  | 1,500              | 0.2                    | 1                       |



Note:

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machines maximum speed, or when the tool is chattering and heats up to a red color.
- Every coolant offers stable milling.

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.03~R6

**HSB**



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●      | ●      | ○      | ○      |           |                 |          | ○      |          |                       | ○               | ○                     |                  |                                       |

**Features**

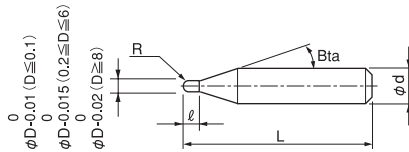
Offers high efficiency, long tool life and excellent surface finish on hard materials over 40HRC.

HARDMAX coat offers heat resistance, durability and lubricity at a high level.

Every coolant offers stable milling.

Ball tip point is designed with a negative rake angle that minimizes wear and improves the target dimensions.

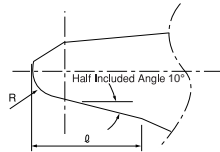
The low negative rake angle at the peripheral side of the ball offers an excellent surface finish and prevents deflection.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

**ATTENTION**

HSB 1001-0020-6 (R0.05) is a taper ball end mill with half included angle 10° (See the right drawing).



| Radius of Ball Nose | Diameter Tolerance | Radius Accuracy | Helix Angle | Number of Flutes |
|---------------------|--------------------|-----------------|-------------|------------------|
| R0.03 ~ R0.05       | 0/-0.01            | ±0.002          | 0°          | 2 Flutes *       |
| R0.1 ~ R3           | 0/-0.015           | ±0.005          | 30°         |                  |
| R4 ~ R6             | 0/-0.02            | ±0.007          |             |                  |

\* Only HSB 1001-0020-6 has single flute.  
R accuracy: ±0.005, Diameter tolerance: 0/-0.015

Total 71 models

Unit (mm)

| Model Number    | Radius of Ball Nose R | Length of Cut l | Shank Taper Angle Bta | Overall Length L | Shank Diameter phi d | Suggested Retail Price ¥ |
|-----------------|-----------------------|-----------------|-----------------------|------------------|----------------------|--------------------------|
| HSB 20006-0006  | R0.03                 | 0.06            | 11°                   | 50               | 4                    | 17,460                   |
| HSB 20008-0008  | R0.04                 | 0.08            | 11°                   | 50               | 4                    | 14,550                   |
| HSB 1001-0020-6 | R0.05                 | 0.2             | 11°                   | 50               | 6                    | 13,320                   |
| HSB 2001-0010   | R0.05                 | 0.1             | 11°                   | 50               | 4                    | 12,120                   |
| HSB 2002-0020-6 | R0.1                  | 0.2             | 16°                   | 50               | 6                    | 9,840                    |
| HSB 2002-0030   |                       | 0.3             |                       | 50               | 4                    | 8,520                    |
| HSB 2003-0030   |                       | 0.3             |                       | 50               | 4                    | 6,960                    |
| HSB 2003-0030-6 | R0.15                 | 0.3             | 16°                   | 50               | 6                    | 8,400                    |
| HSB 2003-0045   |                       | 0.45            |                       | 50               | 4                    | 6,960                    |
| HSB 2004-0040   |                       | 0.4             |                       | 50               | 4                    | 4,680                    |
| HSB 2004-0040-6 | R0.2                  | 0.4             | 16°                   | 50               | 6                    | 6,120                    |
| HSB 2004-0060   |                       | 0.6             |                       | 50               | 4                    | 4,680                    |
| HSB 2005-0050   |                       | 0.5             |                       | 50               | 4                    | 4,320                    |
| HSB 2005-0050-6 | R0.25                 | 0.5             | 16°                   | 50               | 6                    | 5,760                    |
| HSB 2005-0075   |                       | 0.75            |                       | 50               | 4                    | 4,320                    |

- phi 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Unit (mm)

| Model Number    | Radius of Ball Nose R | Length of Cut $l$ | Shank Taper Angle B $\alpha$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|-----------------------|-------------------|------------------------------|------------------|-------------------------|--------------------------|
| HSB 2006-0060   | R0.3                  | 0.6               | 16°                          | 50               | 4                       | 4,200                    |
| HSB 2006-0060-6 |                       | 0.6               |                              | 50               | 6                       | 5,520                    |
| HSB 2006-0090   |                       | 0.9               |                              | 50               | 4                       | 4,200                    |
| HSB 2007-0100   | R0.35                 | 1                 | 16°                          | 50               | 4                       | 8,000                    |
| HSB 2008-0080   | R0.4                  | 0.8               | 16°                          | 50               | 4                       | 4,200                    |
| HSB 2008-0080-6 |                       | 0.8               |                              | 50               | 6                       | 5,520                    |
| HSB 2008-0120   |                       | 1.2               |                              | 50               | 4                       | 4,200                    |
| HSB 2009-0130   | R0.45                 | 1.3               | 16°                          | 50               | 4                       | 8,000                    |
| HSB 2010-0100   | R0.5                  | 1                 | 16°                          | 50               | 4                       | 3,840                    |
| HSB 2010-0100-6 |                       | 1                 |                              | 50               | 6                       | 5,160                    |
| HSB 2010-0150   |                       | 1.5               |                              | 50               | 4                       | 3,840                    |
| HSB 2010-0250   |                       | 2.5               |                              | 50               | 4                       | 3,840                    |
| HSB 2011-0160   | R0.55                 | 1.6               | 16°                          | 50               | 4                       | 9,280                    |
| HSB 2012-0180   | R0.6                  | 1.8               | 16°                          | 50               | 4                       | 5,400                    |
| HSB 2013-0190   | R0.65                 | 1.9               | 16°                          | 50               | 4                       | 9,280                    |
| HSB 2014-0210   | R0.7                  | 2.1               | 16°                          | 50               | 4                       | 5,400                    |
| HSB 2015-0150   | R0.75                 | 1.5               | 16°                          | 50               | 4                       | 4,680                    |
| HSB 2015-0150-6 |                       | 1.5               |                              | 50               | 6                       | 6,000                    |
| HSB 2015-0200   |                       | 2                 |                              | 50               | 4                       | 4,680                    |
| HSB 2015-0225   |                       | 2.25              |                              | 50               | 4                       | 4,680                    |
| HSB 2015-0400   | R0.8                  | 4                 | 16°                          | 50               | 4                       | 4,680                    |
| HSB 2016-0240   |                       | 2.4               |                              | 50               | 4                       | 5,400                    |
| HSB 2017-0250   | R0.85                 | 2.5               | 16°                          | 50               | 4                       | 9,280                    |
| HSB 2018-0270   | R0.9                  | 2.7               | 16°                          | 50               | 4                       | 8,000                    |
| HSB 2019-0280   | R0.95                 | 2.8               | 16°                          | 50               | 4                       | 9,280                    |
| HSB 2020-0200   | R1                    | 2                 | 16°                          | 50               | 4                       | 3,480                    |
| HSB 2020-0200-6 |                       | 2                 |                              | 60               | 6                       | 4,680                    |
| HSB 2020-0300   |                       | 3                 |                              | 50               | 4                       | 3,480                    |
| HSB 2020-0600   |                       | 6                 |                              | 60               | 4                       | 3,480                    |
| HSB 2025-0250   | R1.25                 | 2.5               | 16°                          | 50               | 4                       | 5,950                    |
| HSB 2025-0250-6 |                       | 2.5               |                              | 60               | 6                       | 6,360                    |
| HSB 2025-0375   |                       | 3.75              |                              | 50               | 4                       | 5,950                    |
| HSB 2025-0600   | R1.5                  | 6                 | 16°                          | 60               | 4                       | 5,950                    |
| HSB 2030-0300   |                       | 3                 |                              | 50               | 6                       | 4,200                    |
| HSB 2030-0450   |                       | 4.5               |                              | 70               | 6                       | 4,200                    |
| HSB 2030-0800   |                       | 8                 |                              | 70               | 6                       | 4,200                    |
| HSB 2040-0400   | R2                    | 4                 | 16°                          | 50               | 6                       | 4,800                    |
| HSB 2040-0600-4 |                       | 6                 | —                            | 70               | 4                       | 4,300                    |
| HSB 2040-0600   |                       | 6                 | 16°                          | 70               | 6                       | 4,800                    |
| HSB 2040-0800   |                       | 8                 |                              | 70               | 6                       | 4,800                    |
| HSB 2050-0500   | R2.5                  | 5                 | 16°                          | 50               | 6                       | 5,710                    |
| HSB 2050-0750   |                       | 7.5               |                              | 80               | 6                       | 5,760                    |
| HSB 2050-0800   |                       | 8                 |                              | 80               | 6                       | 5,760                    |
| HSB 2050-1200   |                       | 12                |                              | 80               | 6                       | 5,760                    |
| HSB 2060-0600   | R3                    | 6                 | —                            | 50               | 6                       | 5,940                    |
| HSB 2060-0900   |                       | 9                 |                              | 80               | 6                       | 6,000                    |
| HSB 2060-1200   |                       | 12                |                              | 80               | 6                       | 6,000                    |
| HSB 2080-0800   | R4                    | 8                 | —                            | 60               | 8                       | 9,270                    |
| HSB 2080-1200   |                       | 12                |                              | 90               | 8                       | 9,360                    |
| HSB 2080-1400   |                       | 14                |                              | 90               | 8                       | 9,360                    |
| HSB 2100-1000   | R5                    | 10                | —                            | 70               | 10                      | 12,110                   |
| HSB 2100-1500   |                       | 15                |                              | 100              | 10                      | 12,240                   |
| HSB 2100-1800   |                       | 18                |                              | 100              | 10                      | 12,240                   |
| HSB 2120-1200   | R6                    | 12                | —                            | 75               | 12                      | 20,580                   |
| HSB 2120-1800   |                       | 18                |                              | 110              | 12                      | 20,790                   |
| HSB 2120-2200   |                       | 22                |                              | 110              | 12                      | 20,790                   |

$\phi 3\text{mm}$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral

V Cutter

Drill

Technical Data

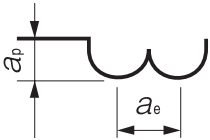
Milling Conditions for HSB / HSB-S

| WORK MATERIAL  |                          |                    | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX (~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11 (55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10 (62~66HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP72 (66~70HRC) |                    |                                 |                                  |
|----------------|--------------------------|--------------------|--|--------------------|---------------------------------|----------------------------------|-------------------------------------|--------------------|---------------------------------|----------------------------------|-------------------------------------|--------------------|---------------------------------|----------------------------------|-------------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number   | Radius of Ball Nose (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                             | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 20006-0006     | R0.03                    | 0.06               | 30,000   | 100                | 0.002 or below                  | 0.02                             | —                                   | —                  | —                               | —                                | —                                   | —                  | —                               | —                                | —                                   | —                  | —                               | —                                |
| 20008-0008     | R0.04                    | 0.08               | 30,000   | 130                | 0.003 or below                  | 0.03                             | —                                   | —                  | —                               | —                                | —                                   | —                  | —                               | —                                | —                                   | —                  | —                               | —                                |
| 1001-0020-6    | R0.05                    | 0.2                | 30,000   | 30                 | 0.002 or below                  | 0.02                             | —                                   | —                  | —                               | —                                | —                                   | —                  | —                               | —                                | —                                   | —                  | —                               | —                                |
| 2001-0010      |                          | 0.1                | 30,000   | 200                | 0.004 or below                  | 0.04                             | —                                   | —                  | —                               | —                                | —                                   | —                  | —                               | —                                | —                                   | —                  | —                               | —                                |
| 2002-0020 (-6) | R0.1                     | 0.2                | 60,000   | 200                | 0.003                           | 0.005                            | 60,000                              | 200                | 0.002                           | 0.003                            | 60,000                              | 130                | 0.002                           | 0.003                            | 45,000                              | 65                 | 0.002                           | 0.003                            |
| 2002-0030      |                          | 0.3                | 60,000   | 200                | 0.003                           | 0.005                            | 60,000                              | 200                | 0.002                           | 0.003                            | 60,000                              | 130                | 0.002                           | 0.003                            | 45,000                              | 65                 | 0.002                           | 0.003                            |
| 2003-0030 (-6) | R0.15                    | 0.3                | 60,000   | 350                | 0.006                           | 0.008                            | 45,000                              | 310                | 0.004                           | 0.007                            | 43,500                              | 180                | 0.003                           | 0.005                            | 32,500                              | 90                 | 0.003                           | 0.005                            |
| 2003-0045      |                          | 0.45               | 60,000   | 350                | 0.006                           | 0.008                            | 45,000                              | 310                | 0.004                           | 0.007                            | 43,500                              | 180                | 0.003                           | 0.005                            | 32,500                              | 90                 | 0.003                           | 0.005                            |
| 2004-0040 (-6) | R0.2                     | 0.4                | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                              | 420                | 0.007                           | 0.012                            | 35,000                              | 240                | 0.005                           | 0.008                            | 26,250                              | 120                | 0.005                           | 0.008                            |
| 2004-0060      |                          | 0.6                | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                              | 420                | 0.007                           | 0.012                            | 35,000                              | 240                | 0.005                           | 0.008                            | 26,250                              | 120                | 0.005                           | 0.008                            |
| 2005-0050 (-6) | R0.25                    | 0.5                | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                              | 530                | 0.01                            | 0.02                             | 30,000                              | 300                | 0.007                           | 0.01                             | 22,500                              | 150                | 0.007                           | 0.01                             |
| 2005-0075      |                          | 0.75               | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                              | 530                | 0.01                            | 0.02                             | 30,000                              | 300                | 0.007                           | 0.01                             | 22,500                              | 150                | 0.007                           | 0.01                             |
| 2006-0060 (-6) | R0.3                     | 0.6                | 40,000   | 1,100              | 0.03                            | 0.13                             | 30,000                              | 1,200              | 0.02                            | 0.1                              | 26,500                              | 800                | 0.01                            | 0.075                            | 20,000                              | 400                | 0.01                            | 0.075                            |
| 2006-0090      |                          | 0.9                | 40,000   | 1,100              | 0.03                            | 0.13                             | 30,000                              | 1,200              | 0.02                            | 0.1                              | 26,500                              | 800                | 0.01                            | 0.075                            | 20,000                              | 400                | 0.01                            | 0.075                            |
| 2007-0100      | R0.35                    | 1                  | 37,000   | 1,350              | 0.045                           | 0.17                             | 28,500                              | 1,400              | 0.03                            | 0.135                            | 25,000                              | 900                | 0.015                           | 0.1                              | 18,750                              | 450                | 0.015                           | 0.1                              |
| 2008-0080 (-6) | R0.4                     | 0.8                | 35,000   | 1,600              | 0.06                            | 0.21                             | 27,000                              | 1,600              | 0.04                            | 0.17                             | 23,500                              | 1,000              | 0.02                            | 0.12                             | 17,500                              | 500                | 0.02                            | 0.12                             |
| 2008-0120      |                          | 1.2                | 35,000   | 1,600              | 0.06                            | 0.21                             | 27,000                              | 1,600              | 0.04                            | 0.17                             | 23,500                              | 1,000              | 0.02                            | 0.12                             | 17,500                              | 500                | 0.02                            | 0.12                             |
| 2009-0130      | R0.45                    | 1.3                | 32,500   | 1,650              | 0.1                             | 0.28                             | 25,500                              | 1,800              | 0.055                           | 0.21                             | 22,000                              | 1,300              | 0.025                           | 0.14                             | 16,500                              | 650                | 0.025                           | 0.14                             |
| 2010-0100 (-6) | R0.5                     | 1                  | 30,000   | 1,750              | 0.2                             | 0.4                              | 24,000                              | 2,000              | 0.1                             | 0.3                              | 21,000                              | 1,750              | 0.05                            | 0.2                              | 16,000                              | 875                | 0.05                            | 0.2                              |
| 2010-0150      |                          | 1.5                | 30,000   | 1,750              | 0.2                             | 0.4                              | 24,000                              | 2,000              | 0.1                             | 0.3                              | 21,000                              | 1,750              | 0.05                            | 0.2                              | 16,000                              | 875                | 0.05                            | 0.2                              |
| 2010-0250      |                          | 2.5                | 30,000   | 1,750              | 0.1                             | 0.3                              | 24,000                              | 2,000              | 0.05                            | 0.2                              | 21,000                              | 1,750              | 0.03                            | 0.17                             | 16,000                              | 875                | 0.03                            | 0.17                             |
| 2011-0160      | R0.55                    | 1.6                | 30,000   | 1,900              | 0.21                            | 0.43                             | 22,000                              | 2,000              | 0.105                           | 0.32                             | 19,000                              | 1,750              | 0.05                            | 0.22                             | 14,250                              | 875                | 0.05                            | 0.22                             |
| 2012-0180      | R0.6                     | 1.8                | 30,000   | 2,000              | 0.22                            | 0.46                             | 20,500                              | 2,000              | 0.11                            | 0.34                             | 17,800                              | 1,750              | 0.05                            | 0.23                             | 13,350                              | 875                | 0.05                            | 0.23                             |
| 2013-0190      | R0.65                    | 1.9                | 30,000   | 2,150              | 0.23                            | 0.49                             | 19,000                              | 2,000              | 0.115                           | 0.36                             | 16,600                              | 1,750              | 0.05                            | 0.24                             | 12,450                              | 875                | 0.05                            | 0.24                             |
| 2014-0210      | R0.7                     | 2.1                | 30,000   | 2,300              | 0.24                            | 0.52                             | 18,000                              | 2,000              | 0.12                            | 0.39                             | 15,700                              | 1,750              | 0.055                           | 0.27                             | 11,800                              | 875                | 0.055                           | 0.27                             |
| 2015-0150 (-6) | R0.75                    | 1.5                | 30,000   | 2,450              | 0.25                            | 0.55                             | 17,000                              | 2,000              | 0.12                            | 0.4                              | 15,000                              | 1,750              | 0.06                            | 0.29                             | 11,250                              | 875                | 0.06                            | 0.29                             |
| 2015-0200      |                          | 2                  | 30,000   | 2,450              | 0.25                            | 0.55                             | 17,000                              | 2,000              | 0.12                            | 0.4                              | 15,000                              | 1,750              | 0.06                            | 0.29                             | 11,250                              | 875                | 0.06                            | 0.29                             |
| 2015-0225      |                          | 2.25               | 30,000   | 2,450              | 0.25                            | 0.55                             | 17,000                              | 2,000              | 0.12                            | 0.4                              | 15,000                              | 1,750              | 0.06                            | 0.29                             | 11,250                              | 875                | 0.06                            | 0.29                             |
| 2015-0400      |                          | 4                  | 30,000   | 2,450              | 0.15                            | 0.45                             | 17,000                              | 2,000              | 0.07                            | 0.31                             | 15,000                              | 1,750              | 0.04                            | 0.24                             | 11,250                              | 875                | 0.04                            | 0.24                             |
| 2016-0240      | R0.8                     | 2.4                | 30,000   | 2,550              | 0.25                            | 0.58                             | 16,200                              | 2,000              | 0.13                            | 0.43                             | 14,200                              | 1,750              | 0.06                            | 0.3                              | 10,650                              | 875                | 0.06                            | 0.3                              |
| 2017-0250      | R0.85                    | 2.5                | 30,000   | 2,600              | 0.26                            | 0.61                             | 15,500                              | 2,000              | 0.135                           | 0.46                             | 13,500                              | 1,750              | 0.065                           | 0.32                             | 10,100                              | 875                | 0.065                           | 0.32                             |
| 2018-0270      | R0.9                     | 2.7                | 30,000   | 2,700              | 0.28                            | 0.65                             | 15,000                              | 2,000              | 0.14                            | 0.48                             | 13,000                              | 1,750              | 0.07                            | 0.34                             | 9,750                               | 875                | 0.07                            | 0.34                             |
| 2019-0280      | R0.95                    | 2.8                | 29,000   | 2,800              | 0.3                             | 0.69                             | 14,500                              | 2,000              | 0.145                           | 0.49                             | 12,600                              | 1,750              | 0.075                           | 0.36                             | 9,450                               | 875                | 0.075                           | 0.36                             |
| 2020-0200 (-6) | R1                       | 2                  | 28,000   | 2,900              | 0.3                             | 0.7                              | 14,000                              | 2,100              | 0.15                            | 0.5                              | 12,250                              | 1,800              | 0.08                            | 0.35                             | 9,200                               | 900                | 0.08                            | 0.35                             |
| 2020-0300      |                          | 3                  | 28,000   | 2,900              | 0.3                             | 0.7                              | 14,000                              | 2,100              | 0.15                            | 0.5                              | 12,250                              | 1,800              | 0.08                            | 0.35                             | 9,200                               | 900                | 0.08                            | 0.35                             |
| 2020-0600      |                          | 6                  | 28,000   | 2,900              | 0.2                             | 0.6                              | 14,000                              | 2,100              | 0.1                             | 0.4                              | 12,250                              | 1,800              | 0.06                            | 0.3                              | 9,200                               | 900                | 0.06                            | 0.3                              |
| 2025-0250 (-6) | R1.25                    | 2.5                | 24,500   | 2,950              | 0.35                            | 0.85                             | 12,250                              | 2,150              | 0.17                            | 0.6                              | 10,700                              | 1,850              | 0.1                             | 0.45                             | 8,050                               | 925                | 0.1                             | 0.45                             |
| 2025-0375      |                          | 3.75               | 24,500   | 2,950              | 0.35                            | 0.85                             | 12,250                              | 2,150              | 0.17                            | 0.6                              | 10,700                              | 1,850              | 0.1                             | 0.45                             | 8,050                               | 925                | 0.1                             | 0.45                             |
| 2025-0600      | 6                        | 24,500             | 2,950  | 0.26               | 0.75                            | 12,250                           | 2,150                               | 0.125              | 0.5                             | 10,700                           | 1,850                               | 0.08               | 0.4                             | 8,050                            | 925                                 | 0.08               | 0.4                             |                                  |
| 2030-0300      | R1.5                     | 3                  | 21,000   | 3,000              | 0.4                             | 1                                | 10,500                              | 2,200              | 0.2                             | 0.7                              | 9,200                               | 1,900              | 0.12                            | 0.55                             | 6,900                               | 950                | 0.12                            | 0.55                             |
| 2030-0450      |                          | 4.5                | 21,000   | 3,000              | 0.4                             | 1                                | 10,500                              | 2,200              | 0.2                             | 0.7                              | 9,200                               | 1,900              | 0.12                            | 0.55                             | 6,900                               | 950                | 0.12                            | 0.55                             |
| 2030-0800      |                          | 8                  | 21,000   | 3,000              | 0.3                             | 0.9                              | 10,500                              | 2,200              | 0.15                            | 0.65                             | 9,200                               | 1,900              | 0.1                             | 0.5                              | 6,900                               | 950                | 0.1                             | 0.5                              |
| 2040-0400      | R2                       | 4                  | 18,000   | 3,200              | 0.5                             | 1.3                              | 9,000                               | 2,300              | 0.25                            | 0.95                             | 7,900                               | 2,000              | 0.15                            | 0.75                             | 5,900                               | 1,000              | 0.15                            | 0.75                             |
| 2040-0600 (-4) |                          | 6                  | 18,000   | 3,200              | 0.5                             | 1.3                              | 9,000                               | 2,300              | 0.25                            | 0.95                             | 7,900                               | 2,000              | 0.15                            | 0.75                             | 5,900                               | 1,000              | 0.15                            | 0.75                             |
| 2040-0800      |                          | 8                  | 18,000   | 3,200              | 0.5                             | 1.3                              | 9,000                               | 2,300              | 0.25                            | 0.95                             | 7,900                               | 2,000              | 0.15                            | 0.75                             | 5,900                               | 1,000              | 0.15                            | 0.75                             |
| 2050-0500      | R2.5                     | 5                  | 15,600   | 3,500              | 0.5                             | 1.5                              | 7,800                               | 2,500              | 0.25                            | 1.05                             | 6,800                               | 2,100              | 0.15                            | 0.85                             | 5,100                               | 1,050              | 0.15                            | 0.85                             |
| 2050-0750      |                          | 7.5                | 15,600   | 3,500              | 0.5                             | 1.5                              | 7,800                               | 2,500              | 0.25                            | 1.05                             | 6,800                               | 2,100              | 0.15                            | 0.85                             | 5,100                               | 1,050              | 0.15                            | 0.85                             |
| 2050-0800      |                          | 8                  | 15,600   | 3,500              | 0.5                             | 1.5                              | 7,800                               | 2,500              | 0.25                            | 1.05                             | 6,800                               | 2,100              | 0.15                            | 0.85                             | 5,100                               | 1,050              | 0.15                            | 0.85                             |
| 2050-1200      |                          | 12                 | 15,600   | 3,500              | 0.5                             | 1.5                              | 7,800                               | 2,500              | 0.25                            | 1.05                             | 6,800                               | 2,100              | 0.15                            | 0.85                             | 5,100                               | 1,050              | 0.15                            | 0.85                             |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for HSB / HSB-S

| WORK MATERIAL |                          |                    | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX (~55HRC) |                    |                        |                         | HARDENED STEELS<br>SKD11 (55~62HRC) |                    |                        |                         | HARDENED STEELS<br>HAP10 (62~66HRC) |                    |                        |                         | HARDENED STEELS<br>HAP72 (66~70HRC) |                    |                        |                         |
|---------------|--------------------------|--------------------|--|--------------------|------------------------|-------------------------|-------------------------------------|--------------------|------------------------|-------------------------|-------------------------------------|--------------------|------------------------|-------------------------|-------------------------------------|--------------------|------------------------|-------------------------|
| Model Number  | Radius of Ball Nose (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> )                             | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2060-0600     | R3                       | 6                  | 13,000   | 3,500              | 0.6                    | 1.8                     | 6,500                               | 2,500              | 0.3                    | 1.3                     | 5,700                               | 2,200              | 0.2                    | 1                       | 4,300                               | 1,100              | 0.2                    | 1                       |
| 2060-0900     |                          | 9                  | 13,000   | 3,500              | 0.6                    | 1.8                     | 6,500                               | 2,500              | 0.3                    | 1.3                     | 5,700                               | 2,200              | 0.2                    | 1                       | 4,300                               | 1,100              | 0.2                    | 1                       |
| 2060-1200     |                          | 12                 | 13,000   | 3,500              | 0.6                    | 1.8                     | 6,500                               | 2,500              | 0.3                    | 1.3                     | 5,700                               | 2,200              | 0.2                    | 1                       | 4,300                               | 1,100              | 0.2                    | 1                       |
| 2080-0800     | R4                       | 8                  | 9,500  | 3,000              | 0.7                    | 2.1                     | 5,200                               | 2,200              | 0.4                    | 1.7                     | 4,500                               | 1,900              | 0.25                   | 1.35                    | 3,400                               | 950                | 0.25                   | 1.35                    |
| 2080-1200     |                          | 12                 | 9,500  | 3,000              | 0.7                    | 2.1                     | 5,200                               | 2,200              | 0.4                    | 1.7                     | 4,500                               | 1,900              | 0.25                   | 1.35                    | 3,400                               | 950                | 0.25                   | 1.35                    |
| 2080-1400     |                          | 14                 | 9,500  | 3,000              | 0.7                    | 2.1                     | 5,200                               | 2,200              | 0.4                    | 1.7                     | 4,500                               | 1,900              | 0.25                   | 1.35                    | 3,400                               | 950                | 0.25                   | 1.35                    |
| 2100-1000     | R5                       | 10                 | 7,500  | 2,500              | 0.8                    | 2.5                     | 4,300                               | 2,000              | 0.5                    | 2.1                     | 3,750                               | 1,750              | 0.3                    | 1.7                     | 2,800                               | 875                | 0.3                    | 1.7                     |
| 2100-1500     |                          | 15                 | 7,500  | 2,500              | 0.8                    | 2.5                     | 4,300                               | 2,000              | 0.5                    | 2.1                     | 3,750                               | 1,750              | 0.3                    | 1.7                     | 2,800                               | 875                | 0.3                    | 1.7                     |
| 2100-1800     |                          | 18                 | 7,500  | 2,500              | 0.8                    | 2.5                     | 4,300                               | 2,000              | 0.5                    | 2.1                     | 3,750                               | 1,750              | 0.3                    | 1.7                     | 2,800                               | 875                | 0.3                    | 1.7                     |
| 2120-1200     | R6                       | 12                 | 6,200  | 2,000              | 0.9                    | 3                       | 3,600                               | 1,750              | 0.6                    | 2.6                     | 3,150                               | 1,500              | 0.35                   | 2                       | 2,350                               | 750                | 0.35                   | 2                       |
| 2120-1800     |                          | 18                 | 6,200  | 2,000              | 0.9                    | 3                       | 3,600                               | 1,750              | 0.6                    | 2.6                     | 3,150                               | 1,500              | 0.35                   | 2                       | 2,350                               | 750                | 0.35                   | 2                       |
| 2120-2200     |                          | 22                 | 6,200  | 2,000              | 0.9                    | 3                       | 3,600                               | 1,750              | 0.6                    | 2.6                     | 3,150                               | 1,500              | 0.35                   | 2                       | 2,350                               | 750                | 0.35                   | 2                       |



Note:

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machines maximum speed, or when the tool is chattering and heats up to a red color.
- Reduce the milling parameters when a straight shank tool exceeds 35 mm of overhang length.
- Every coolant offers stable milling.

## Constant Velocity Joint

## DRM2 (62HRC)

Work Size  $\phi 100 \times 50$  mm

Coolant Oil Mist

6 Flute Square for Hard Materials **HMS**2 Flute Ball for Hard Materials **HSB**

| Milling Process | Tool                            | Milling Spot | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Allowance (mm) | Cycle Time (h:m:s) |
|-----------------|---------------------------------|--------------|------------------------------------|--------------------|------------|------------|----------------|--------------------|
| Roughing        | HSB R5                          | Pilot Hole   | 600                                | 240                | 1          | —          | —              | 4:52               |
|                 | HMS $\phi 10$<br>6 Flute Square | Dimension    | 4,000                              | 200                | 16         | 0.1        | —              | 3:49               |
| 2,500           |                                 |              |                                    | 16                 | 0.2        | 0.02       | 2:12           |                    |
| Finishing       | HSB R5                          | Contour      | 3,150                              | 800                | 0.05       | 7          | 0              | 1:24               |
| Roughing        |                                 |              |                                    |                    | 0.5        | 2          | 0.2            | 24:36              |
| Semi-finishing  | HSB R2                          | Contour      | 15,000                             | 1,400              | 0.25       | 0.7        | 0.07           | 15:18              |
|                 | HSB R1                          | Contour      | 18,000                             | 1,800              | 0.15       | 0.15       | 0.02           | 21:58              |
| Finishing       | HSB R1                          | Dimension    | 20,000                             | 1,000              | 0.05       | —          | 0              | 0:51               |
|                 | CBN R1                          | Contour      | 20,000                             | 1,800              | 0.07       | 0.04       | 0              | 71:19              |

2:26:12

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data





Size R0.1~R2

Short Shank Series

# HSB-S



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●      | ●      | ○      | ○      |           |                 |          | ○      |          |                       | ○               | ○                     |                  |                                       |

## Features

Short Shank Ball End Mills for high accuracy shrink-fit tool holder.

Offers high efficiency, long tool life and excellent surface finish on hard materials over 40HRC.

HARDMAX coat offers heat resistance, durability and lubricity at a high level.

Every coolant offers stable milling.

Ball tip point is designed with a negative rake angle that minimizes wear and improves the target dimensions.

The low negative rake angle at the peripheral side of the ball offers an excellent surface finish and prevents deflection.

Better Tolerance Design! Diameter Tolerance, Ball Radius Accuracy, and Shank Diameter Tolerance

## HSB / HSLB Tolerance

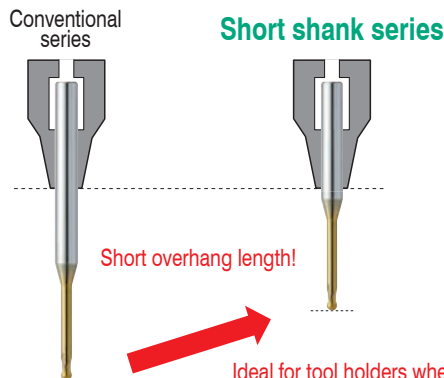
| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy | Shank Diameter Tolerance |
|---------------------|--------------------|----------------------|--------------------------|
| R0.1 ~ R3           | 0/-0.015           | ±0.005               | 0/-0.005 (h5)            |

## HSB-S / HSLB-S Tolerance

| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy | Shank Diameter Tolerance |
|---------------------|--------------------|----------------------|--------------------------|
| R0.1 ~ R1           | <b>0/-0.008</b>    | <b>±0.003</b>        | <b>0/-0.004 (h4)</b>     |
| R1.5 ~ R2           | <b>0/-0.01</b>     |                      |                          |
| R3                  |                    | ±0.005               |                          |

Shank diameter tolerance h4!

Short overhang length with short shank length!



Short overhang length minimizes tool run-out

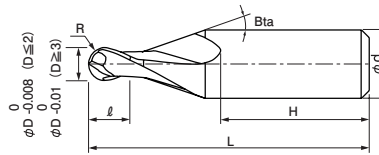
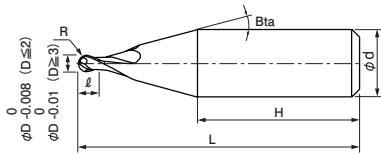
High precision milling

Minimizes vibration and chattering

Longer tool life

Ideal for tool holders where the maximum insertion is short.





The shank taper angle and the shank length (H) shown are not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 10 models

Unit (mm)

| Model Number   | Radius of Ball Nose R | Length of Cut $\ell$ | Shank Taper Angle $B\alpha$ | Overall Length L | Shank Diameter $\phi d$ | Shank Length H | Suggested Retail Price ¥ |
|----------------|-----------------------|----------------------|-----------------------------|------------------|-------------------------|----------------|--------------------------|
| HSB 2002-0020S | RO.1                  | 0.2                  | 16°                         | 35               | 4                       | 26.0           | 8,520                    |
| HSB 2003-0030S | RO.15                 | 0.3                  | 16°                         | 35               | 4                       | 26.0           | 6,960                    |
| HSB 2004-0040S | RO.2                  | 0.4                  | 16°                         | 35               | 4                       | 26.0           | 4,680                    |
| HSB 2006-0060S | RO.3                  | 0.6                  | 16°                         | 35               | 4                       | 26.0           | 4,200                    |
| HSB 2008-0080S | RO.4                  | 0.8                  | 16°                         | 35               | 4                       | 26.5           | 4,200                    |
| HSB 2010-0100S | RO.5                  | 1                    | 16°                         | 35               | 4                       | 26.5           | 3,840                    |
| HSB 2015-0150S | RO.75                 | 1.5                  | 16°                         | 35               | 4                       | 26.5           | 4,680                    |
| HSB 2020-0200S | R1                    | 2                    | 16°                         | 35               | 4                       | 25.5           | 3,480                    |
| HSB 2030-0300S | R1.5                  | 3                    | 16°                         | 40               | 6                       | 27.0           | 4,200                    |
| HSB 2040-0400S | R2                    | 4                    | 16°                         | 40               | 6                       | 26.0           | 4,800                    |

## Press Die

DC53 (60HRC)



Work Size 100 × 120 × 50 mm  
Coolant Oil Mist

Tool used mainly

HSB

HSLB



| Milling Process | Tool                          |                                 | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm)      | $a_e$ (mm)        | Cycle Time (h:m:s) | Milling Distance (m) |
|-----------------|-------------------------------|---------------------------------|------------------------------------|--------------------|-----------------|-------------------|--------------------|----------------------|
| Roughing        | HSB 2 Flute Ball              | R4                              | 5,200                              | 2,200              | 0.4             | 1.7               | 2:52:35            | 334                  |
| Roughing        | HSLB 2 Flute Long Neck Ball   | R3 × EL30                       | 6,500                              | 2,500              | 0.2             | 0.65              | 0:28:01            | 46                   |
| Semi-finishing  |                               | R2 × EL25                       | 8,000                              | 1,160              | 0.7 (Ridgeline) | 0.35 (Orthogonal) | 0:21:38            | 18                   |
| Semi-finishing  |                               | R3 × EL30                       | 6,500                              | 2,500              | 0               | 0.3               | 0:21:38            | 48                   |
| Finishing       |                               | R3 × EL30                       | 6,500                              | 2,500              | 0               | 0.01              | 2:53:09            | 274                  |
| Finishing       | HLRS 4 Flute Long Neck Radius | $\phi 6 \times EL30 \times CR1$ | 2,200                              | 580                | 0.1             | 1                 | 1:03:01            | 23                   |
| Drilling        | HSB 2 Flute Ball              | R0.3                            | 30,000                             | 1,200              | 0.05            | 0                 | 0:02:09            | 1.6                  |

8:02:11

748

3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



Size R1.5~R6

**HBL**



R1.5~R3

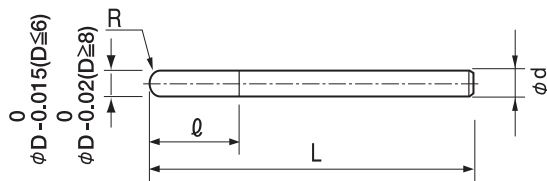
R4~R6

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●      | ○      |        |        | ○         |                 |          | ●      |          |                       | ○               | ○                     |                  |                                       |

**Features**

Long shank ball design for hard materials.  
**HARDMAX** coating for high speed milling for Hard Materials.  
 Both dry and wet coolant offer stable and long tool life.  
 Diameter Tolerance: 0/-0.015 (D≤6), 0/-0.02 (D≥8)



Shank part should not make contact with the work piece.

Total 6 models

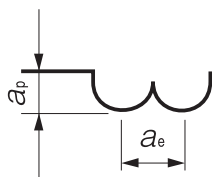
Unit (mm)

| Model Number  | Radius of Ball Nose R | Length of Cut ℓ | Overall Length L | Shank Diameter φd | Suggested Retail Price ¥ |
|---------------|-----------------------|-----------------|------------------|-------------------|--------------------------|
| HBL 2030-0800 | R1.5                  | 4.5             | 80               | 3                 | 12,200                   |
| HBL 2040-1000 | R2                    | 6               | 100              | 4                 | 13,900                   |
| HBL 2060-1400 | R3                    | 18              | 140              | 6                 | 21,100                   |
| HBL 2080-1600 | R4                    | 20              | 160              | 8                 | 29,480                   |
| HBL 2100-1800 | R5                    | 25              | 180              | 10                | 35,700                   |
| HBL 2120-2000 | R6                    | 25              | 200              | 12                | 46,090                   |

## Milling Conditions for HBL

| WORK MATERIAL |                          | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                    |                        |                         | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                    |                        |                         | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                        |                         |
|---------------|--------------------------|--|--------------------|------------------------|-------------------------|---|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> )       | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )            | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                               | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2030-0800     | R1.5                     | 16,000                                   | 800                | 0.12                   | 0.3                     | 13,300  | 580                | 0.12                   | 0.3                     | 10,700   | 420                | 0.12                   | 0.3                     |
| 2040-1000     | R2                       | 12,000                                   | 840                | 0.16                   | 0.4                     | 10,000  | 560                | 0.16                   | 0.4                     | 8,000  | 400                | 0.16                   | 0.4                     |
| 2060-1400     | R3                       | 8,000                                    | 960                | 0.24                   | 0.6                     | 6,700   | 670                | 0.24                   | 0.6                     | 5,400  | 480                | 0.24                   | 0.6                     |
| 2080-1600     | R4                       | 6,000                                    | 1,050              | 0.32                   | 0.8                     | 5,000   | 700                | 0.32                   | 0.8                     | 4,000  | 520                | 0.32                   | 0.8                     |
| 2100-1800     | R5                       | 4,800                                    | 1,100              | 0.4                    | 1                       | 4,000   | 730                | 0.4                    | 1                       | 3,200  | 540                | 0.4                    | 1                       |
| 2120-2000     | R6                       | 4,000                                    | 1,130              | 0.48                   | 1.2                     | 3,400   | 810                | 0.48                   | 1.2                     | 2,700  | 590                | 0.48                   | 1.2                     |

| WORK MATERIAL |                          | HARDENED STEELS<br>SKD61 / SKT<br>(45~50HRC) |                    |                        |                         | HARDENED STEELS<br>SKD61 / 11<br>(50~60HRC) |                    |                        |                         |
|---------------|--------------------------|--|--------------------|------------------------|-------------------------|---|--------------------|------------------------|-------------------------|
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> )           | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )          | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2030-0800     | R1.5                     | 6,400  | 230                | 0.12                   | 0.3                     | 4,800                                       | 90                 | 0.12                   | 0.3                     |
| 2040-1000     | R2                       | 4,800  | 230                | 0.16                   | 0.4                     | 3,600                                       | 100                | 0.16                   | 0.4                     |
| 2060-1400     | R3                       | 3,200  | 250                | 0.24                   | 0.6                     | 2,400                                       | 110                | 0.24                   | 0.6                     |
| 2080-1600     | R4                       | 2,400  | 260                | 0.32                   | 0.8                     | 1,800                                       | 110                | 0.32                   | 0.8                     |
| 2100-1800     | R5                       | 2,000  | 300                | 0.4                    | 1                       | 1,500                                       | 120                | 0.4                    | 1                       |
| 2120-2000     | R6                       | 1,600  | 320                | 0.48                   | 1.2                     | 1,200                                       | 140                | 0.48                   | 1.2                     |



Cutting Amount (mm)  
 $a_p = 0.04D$  (Max 0.5 mm)  
 $a_e = 0.1D$   
 $D$  : Outside Diameter (mm)

## Note:

- Decrease both spindle speed and feed rate proportionally in case of chattering.
- Set spindle speed, feed rate, and radial depth in accordance with the required surface quality.
- Adjust milling parameters according to the operating environment when milling a work piece over 60HRC.
- Recommend air blow or oil mist.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend wet coolant for Copper.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.05~R6

**CSEB**

Super  
MG

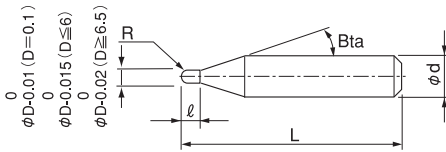
UT  
COAT

Shank Dia  
0/-0.005

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        | ○         | ●               |          | ●      |          |                       | ○               | ○                     |                  |                                       |

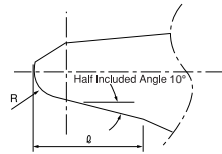
**Features**



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

**ATTENTION**

CSEB 1001-0020-6 is a taper ball end mill with half included angle 10° (See the right drawing).



| Radius of Ball Nose | Diameter Tolerance | Radius Accuracy | Helix Angle | Number of Flutes |
|---------------------|--------------------|-----------------|-------------|------------------|
| R0.05               | 0/-0.01            | ±0.002          | 0°          | 2 Flutes<br>*    |
| R0.1 ~ R3           | 0/-0.015           | ±0.005          | 30°         |                  |
| R3.25 ~ R6          | 0/-0.02            | ±0.007          | 30°         |                  |

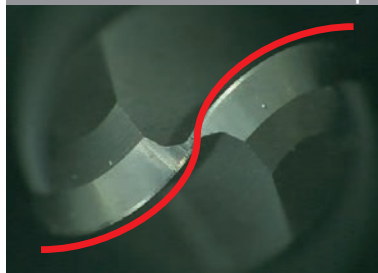
\* Only CSEB 1001-0020-6 has single flute.  
R accuracy and diameter tolerance is the same as R0.1.

**3 Features of CSEB**

Reduce cutting resistance and designed to require surface quality.

Recommended for milling on hardened steels (55HRC) - sticky materials, materials that prone to chatter marks.

Less resistance on curved surface shape



Small relief surface



Tip design with excellent cutting performance



Total 78 models

Unit (mm)

| Model Number     | Radius of Ball Nose R | Length of Cut $\varrho$ | Shank Taper Angle B $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|------------------|-----------------------|-------------------------|-----------------------------|------------------|-------------------------|--------------------------|
| CSEB 1001-0020-6 | RO.05                 | 0.2                     | 11°                         | 50               | 6                       | 13,320                   |
| CSEB 2001-0010   | RO.05                 | 0.1                     | 11°                         | 50               | 4                       | 12,120                   |
| CSEB 2002-0020-6 | RO.1                  | 0.2                     | 11°                         | 50               | 6                       | 9,840                    |
| CSEB 2002-0030   |                       | 0.3                     |                             | 50               | 4                       | 8,520                    |
| CSEB 2003-0030   | RO.15                 | 0.3                     | 11°                         | 50               | 4                       | 6,960                    |
| CSEB 2003-0030-6 |                       | 0.3                     |                             | 50               | 6                       | 8,400                    |
| CSEB 2003-0045   |                       | 0.45                    |                             | 50               | 4                       | 6,960                    |
| CSEB 2004-0040   | RO.2                  | 0.4                     | 11°                         | 50               | 4                       | 4,680                    |
| CSEB 2004-0040-6 |                       | 0.4                     |                             | 50               | 6                       | 6,120                    |
| CSEB 2004-0060   |                       | 0.6                     |                             | 50               | 4                       | 4,680                    |
| CSEB 2005-0050   | RO.25                 | 0.5                     | 11°                         | 50               | 4                       | 4,320                    |
| CSEB 2005-0050-6 |                       | 0.5                     |                             | 50               | 6                       | 5,760                    |
| CSEB 2005-0075   |                       | 0.75                    |                             | 50               | 4                       | 4,320                    |
| CSEB 2006-0060   | RO.3                  | 0.6                     | 11°                         | 50               | 4                       | 4,200                    |
| CSEB 2006-0060-6 |                       | 0.6                     |                             | 50               | 6                       | 5,520                    |
| CSEB 2006-0090   |                       | 0.9                     |                             | 50               | 4                       | 4,200                    |
| CSEB 2007-0100   | RO.35                 | 1                       | 11°                         | 50               | 4                       | 8,000                    |
| CSEB 2008-0080   | RO.4                  | 0.8                     | 11°                         | 50               | 4                       | 4,200                    |
| CSEB 2008-0080-6 |                       | 0.8                     |                             | 50               | 6                       | 5,520                    |
| CSEB 2008-0120   | RO.45                 | 1.2                     | 11°                         | 50               | 4                       | 4,200                    |
| CSEB 2009-0130   |                       | 1.3                     |                             | 50               | 4                       | 8,000                    |
| CSEB 2010-0100   | RO.5                  | 1                       | 11°                         | 50               | 4                       | 3,840                    |
| CSEB 2010-0100-6 |                       | 1                       |                             | 50               | 6                       | 5,160                    |
| CSEB 2010-0150   |                       | 1.5                     |                             | 50               | 4                       | 3,840                    |
| CSEB 2010-0250   |                       | 2.5                     |                             | 50               | 4                       | 3,840                    |
| CSEB 2011-0160   | RO.55                 | 1.6                     | 11°                         | 50               | 4                       | 9,280                    |
| CSEB 2012-0180   | RO.6                  | 1.8                     | 11°                         | 50               | 4                       | 5,400                    |
| CSEB 2013-0190   | RO.65                 | 1.9                     | 11°                         | 50               | 4                       | 9,280                    |
| CSEB 2014-0210   | RO.7                  | 2.1                     | 11°                         | 50               | 4                       | 5,400                    |
| CSEB 2015-0150   | RO.75                 | 1.5                     | 11°                         | 50               | 4                       | 4,680                    |
| CSEB 2015-0150-6 |                       | 1.5                     |                             | 50               | 6                       | 6,000                    |
| CSEB 2015-0200   |                       | 2                       |                             | 50               | 4                       | 4,680                    |
| CSEB 2015-0225   |                       | 2.25                    |                             | 50               | 4                       | 4,680                    |
| CSEB 2015-0400   |                       | 4                       |                             | 50               | 4                       | 4,680                    |
| CSEB 2016-0240   | RO.8                  | 2.4                     | 11°                         | 50               | 4                       | 5,400                    |
| CSEB 2017-0250   | RO.85                 | 2.5                     | 11°                         | 50               | 4                       | 9,280                    |
| CSEB 2018-0270   | RO.9                  | 2.7                     | 11°                         | 50               | 4                       | 8,000                    |
| CSEB 2019-0280   | RO.95                 | 2.8                     | 11°                         | 50               | 4                       | 9,280                    |
| CSEB 2020-0200   | R1                    | 2                       | 11°                         | 50               | 4                       | 3,480                    |
| CSEB 2020-0200-6 |                       | 2                       |                             | 60               | 6                       | 4,680                    |
| CSEB 2020-0300   |                       | 3                       |                             | 60               | 4                       | 3,480                    |
| CSEB 2020-0600   |                       | 6                       |                             | 60               | 4                       | 3,480                    |
| CSEB 2025-0250   | R1.25                 | 2.5                     | 11°                         | 50               | 4                       | 5,950                    |
| CSEB 2025-0250-6 |                       | 2.5                     |                             | 60               | 6                       | 7,200                    |
| CSEB 2025-0375   |                       | 3.75                    |                             | 50               | 4                       | 5,950                    |
| CSEB 2025-0600   |                       | 6                       |                             | 60               | 4                       | 5,950                    |
| CSEB 2030-0300   | R1.5                  | 3                       | 11°                         | 50               | 6                       | 4,200                    |
| CSEB 2030-0450   |                       | 4.5                     |                             | 70               | 6                       | 4,200                    |
| CSEB 2030-0800   |                       | 8                       |                             | 70               | 6                       | 4,200                    |
| CSEB 2035-0520   | R1.75                 | 5.2                     | 11°                         | 70               | 6                       | 7,800                    |
| CSEB 2040-0400   | R2                    | 4                       | 11°                         | 50               | 6                       | 4,800                    |
| CSEB 2040-0600-4 |                       | 6                       | —                           | 70               | 4                       | 4,300                    |
| CSEB 2040-0600   |                       | 6                       | 11°                         | 70               | 6                       | 4,800                    |
| CSEB 2040-0800   |                       | 8                       | 11°                         | 70               | 6                       | 4,800                    |

3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

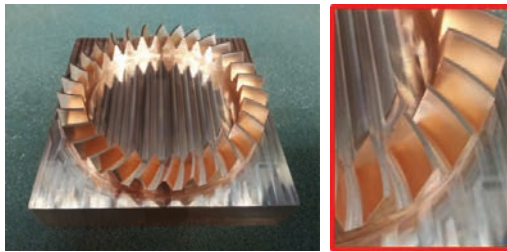
Technical Data

Unit (mm)

| Model Number   | Radius of Ball Nose R | Length of Cut $l$ | Shank Taper Angle B $\alpha$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-----------------------|-------------------|------------------------------|------------------|-------------------------|--------------------------|
| CSEB 2045-0670 | R2.25                 | 6.7               | 11°                          | 70               | 6                       | 10,610                   |
| CSEB 2050-0500 | R2.5                  | 5                 | 11°                          | 50               | 6                       | 5,710                    |
| CSEB 2050-0750 |                       | 7.5               |                              | 80               | 6                       | 5,760                    |
| CSEB 2050-0800 |                       | 8                 |                              | 80               | 6                       | 5,760                    |
| CSEB 2050-1200 |                       | 12                |                              | 80               | 6                       | 5,760                    |
| CSEB 2055-0820 | R2.75                 | 8.2               | 11°                          | 80               | 6                       | 11,660                   |
| CSEB 2060-0600 | R3                    | 6                 | —                            | 50               | 6                       | 5,940                    |
| CSEB 2060-0900 |                       | 9                 |                              | 80               | 6                       | 6,000                    |
| CSEB 2060-1200 |                       | 12                |                              | 80               | 6                       | 6,000                    |
| CSEB 2065-0970 | R3.25                 | 9.7               | 11°                          | 90               | 8                       | 13,200                   |
| CSEB 2070-1050 | R3.5                  | 10.5              | 11°                          | 90               | 8                       | 10,560                   |
| CSEB 2075-1120 | R3.75                 | 11.2              | 11°                          | 90               | 8                       | 13,200                   |
| CSEB 2080-0800 | R4                    | 8                 | —                            | 60               | 8                       | 9,270                    |
| CSEB 2080-1200 |                       | 12                |                              | 90               | 8                       | 9,360                    |
| CSEB 2080-1400 |                       | 14                |                              | 90               | 8                       | 9,360                    |
| CSEB 2085-1270 | R4.25                 | 12.7              | 11°                          | 100              | 10                      | 14,630                   |
| CSEB 2090-1350 | R4.5                  | 13.5              | 11°                          | 100              | 10                      | 14,630                   |
| CSEB 2100-1000 | R5                    | 10                | —                            | 70               | 10                      | 12,110                   |
| CSEB 2100-1500 |                       | 15                |                              | 100              | 10                      | 12,240                   |
| CSEB 2100-1800 |                       | 18                |                              | 100              | 10                      | 12,240                   |
| CSEB 2110-1650 | R5.5                  | 16.5              | 11°                          | 110              | 12                      | 24,420                   |
| CSEB 2120-1200 | R6                    | 12                | —                            | 75               | 12                      | 20,580                   |
| CSEB 2120-1800 |                       | 18                |                              | 110              | 12                      | 20,790                   |
| CSEB 2120-2200 |                       | 22                |                              | 110              | 12                      | 20,790                   |

Copper Milling

C1100



Work Size 100 × 100 × 30 mm  
Coolant Oil Mist

Size R0.05~R6

**CSEB** Super MG UT COAT Share Dia 0.0405



Size R0.05~R3

**CSELB** Super MG UT COAT Start Dia 0.0405 Eco Taper Control



Size  $\phi 1 \sim \phi 20$

**C-CES4000** Super MG UT COAT 30° Flatland Share Dia 0.0405



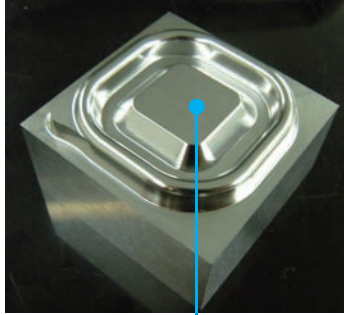
| Tool                         |                         | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Cycle Time (h:m:s) |
|------------------------------|-------------------------|------------------------------------|--------------------|------------|------------|--------------------|
| C-CES 4 Flute Square         | $\phi 6 \times L13$     | 12,000                             | 3,600              | 0.35       | 4          | 0:52:51            |
| CSELB 2 Flute Long Neck Ball | R1.5 × EL16             | 16,000                             | 1,200              | 0.27       | 0.45       | 1:04:57            |
| C-CES 4 Flute Square         | $\phi 6 \times L13$     | 16,000                             | 500                | 0.1        | 3.5        | 0:15:54            |
| C-CES 4 Flute Square         | $\phi 6 \times L13$     | 6,000                              | 200 ~ 500          | 11         | 0.05       | 0:03:42            |
| CSEB 2 Flute Ball            | R0.5                    | 18,000                             | 1,800              | 0.3        | 0.3        | 2:34:10            |
| C-CES 4 Flute Square         | $\phi 1.5 \times L3.75$ | 15,000                             | 1,200              | —          | 0.03       | 0:08:14            |

4:59:48

## Milling example of plastic mold

HPM38 (53HRC)

## ◆Optimized Ball Tip Effect



CSEB 2040-0600



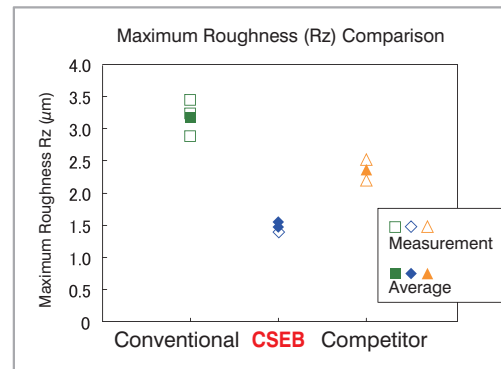
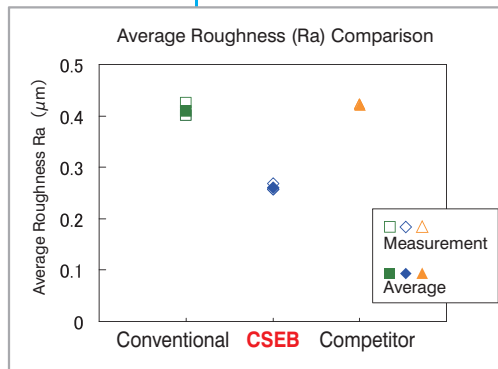
CSEB 2020-0300



CSEB 2010-0150



Work Size  
50 × 50 × 30 mm



Optimized ball tip offers outstandingly nano-smooth surface on finishing.

| No | Milling Process | Tool<br>(Radius of Ball Nose<br>× Length of Cut) | Spindle<br>Speed<br>(min <sup>-1</sup> ) | Feed<br>Rate<br>(mm/min) | $a_p$<br>(mm) | $a_e$<br>(mm) | Overhang<br>Length<br>(mm) | Cycle<br>Time<br>(h:m:s) | Coolant  |
|----|-----------------|--|--|--------------------------|---------------|---------------|----------------------------|--------------------------|----------|
| 1  | Roughing        | CSEB 2040-0600<br>(R2×6)                         | 11,000                                   | 2,000                    | 0.34          | 1             | 15                         | 0:31:21                  | Air Blow |
| 2  | Semi-finishing  | CSEB 2020-0300<br>(R1×3)                         | 16,000                                   | 1,300                    | 0.17          | 0.5           | 13                         | 0:03:10                  | Air Blow |
| 3  |                 |  | 16,000                                   | 1,300                    | 0.1           | 0.1           | 13                         | 0:16:47                  | Air Blow |
| 4  |                 |  | 16,000                                   | 1,300                    | 0.01          | 0.1           | 13                         | 0:37:00                  | Oil Mist |
| 5  | Finishing       | CSEB 2010-0150<br>(R0.5×1.5)                     | 22,000                                   | 1,300                    | 0.04          | 0.18          | 12                         | 0:05:06                  | Oil Mist |
| 6  |                 |  | 22,000                                   | 700                      | 0.05          | 0.05          | 12                         | 0:59:36                  | Oil Mist |
| 7  |                 |  | 22,000                                   | 700                      | 0.01          | 0.05          | 12                         | 0:30:43                  | Oil Mist |

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for CSEB

| WORK MATERIAL |                          |                    | COPPER / ALUMINUM ALLOYS           |                    |                                 |                                  | CARBON STEELS / ALLOY STEELS<br>S45C / S50C / SK / SCM<br>(~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>NAK80 / STAVAX / HPM38<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>STAVAX / HPM38 / SKD61<br>(45~55HRC) |                    |                                 |                                  |
|---------------|--------------------------|--------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                                 | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 1001-0020-6   | R0.05                    | 0.2                | 30,000                             | 30                 | 0.002 or below                  | 0.02                             | 30,000   | 30                 | 0.002 or below                  | 0.02                             | 30,000   | 30                 | 0.002 or below                  | 0.02                             | 30,000  | 30                 | 0.002 or below                  | 0.02                             |
| 2001-0010     |                          | 0.1                | 30,000                             | 200                | 0.004 or below                  | 0.04                             | 30,000   | 200                | 0.004 or below                  | 0.04                             | 30,000   | 200                | 0.004 or below                  | 0.04                             | 30,000  | 200                | 0.004 or below                  | 0.04                             |
| 2002-0020-6   | R0.1                     | 0.2                | 60,000                             | 350                | 0.008                           | 0.024                            | 60,000   | 350                | 0.008                           | 0.016                            | 60,000   | 300                | 0.008                           | 0.024                            | 60,000  | 300                | 0.006                           | 0.018                            |
| 2002-0030     |                          | 0.3                | 60,000                             | 350                | 0.008                           | 0.024                            | 60,000   | 350                | 0.008                           | 0.016                            | 60,000   | 300                | 0.008                           | 0.024                            | 60,000  | 300                | 0.006                           | 0.018                            |
| 2003-0030(-6) | R0.15                    | 0.3                | 43,000                             | 500                | 0.012                           | 0.036                            | 43,000   | 500                | 0.012                           | 0.024                            | 54,000   | 450                | 0.012                           | 0.036                            | 43,000  | 450                | 0.008                           | 0.024                            |
| 2003-0045     |                          | 0.45               | 43,000                             | 500                | 0.012                           | 0.036                            | 43,000   | 500                | 0.012                           | 0.024                            | 54,000   | 450                | 0.012                           | 0.036                            | 43,000  | 450                | 0.008                           | 0.024                            |
| 2004-0040(-6) | R0.2                     | 0.4                | 35,000                             | 1,200              | 0.03                            | 0.09                             | 35,000   | 1,200              | 0.02                            | 0.04                             | 50,000   | 650                | 0.025                           | 0.075                            | 35,000  | 650                | 0.015                           | 0.045                            |
| 2004-0060     |                          | 0.6                | 35,000                             | 1,200              | 0.03                            | 0.09                             | 35,000   | 1,200              | 0.02                            | 0.04                             | 50,000   | 650                | 0.025                           | 0.075                            | 35,000  | 650                | 0.015                           | 0.045                            |
| 2005-0050(-6) | R0.25                    | 0.5                | 34,000                             | 1,300              | 0.035                           | 0.105                            | 34,000   | 1,300              | 0.03                            | 0.06                             | 45,000   | 900                | 0.03                            | 0.09                             | 32,000  | 900                | 0.02                            | 0.06                             |
| 2005-0075     |                          | 0.75               | 34,000                             | 1,300              | 0.035                           | 0.105                            | 34,000   | 1,300              | 0.03                            | 0.06                             | 45,000   | 900                | 0.03                            | 0.09                             | 32,000  | 900                | 0.02                            | 0.06                             |
| 2006-0060(-6) | R0.3                     | 0.6                | 33,000                             | 1,500              | 0.05                            | 0.15                             | 33,000   | 1,500              | 0.04                            | 0.08                             | 40,000   | 1,300              | 0.045                           | 0.09                             | 30,000  | 1,300              | 0.04                            | 0.06                             |
| 2006-0090     |                          | 0.9                | 33,000                             | 1,500              | 0.05                            | 0.15                             | 33,000   | 1,500              | 0.04                            | 0.08                             | 40,000   | 1,300              | 0.045                           | 0.09                             | 30,000  | 1,300              | 0.04                            | 0.06                             |
| 2007-0100     | R0.35                    | 1                  | 32,000                             | 1,800              | 0.07                            | 0.21                             | 32,000   | 1,600              | 0.05                            | 0.1                              | 38,000   | 1,600              | 0.06                            | 0.12                             | 28,000  | 1,600              | 0.05                            | 0.075                            |
| 2008-0080(-6) | R0.4                     | 0.8                | 30,000                             | 2,200              | 0.1                             | 0.3                              | 30,000   | 1,800              | 0.06                            | 0.12                             | 35,000   | 1,800              | 0.07                            | 0.14                             | 25,000  | 1,700              | 0.07                            | 0.1                              |
| 2008-0120     |                          | 1.2                | 30,000                             | 2,200              | 0.1                             | 0.3                              | 30,000   | 1,800              | 0.06                            | 0.12                             | 35,000   | 1,800              | 0.07                            | 0.14                             | 25,000  | 1,700              | 0.07                            | 0.1                              |
| 2009-0130     | R0.45                    | 1.3                | 30,000                             | 2,100              | 0.11                            | 0.33                             | 30,000   | 1,600              | 0.07                            | 0.14                             | 33,000   | 1,700              | 0.08                            | 0.16                             | 24,000  | 1,600              | 0.08                            | 0.12                             |
| 2010-0100(-6) | R0.5                     | 1                  | 30,000                             | 2,000              | 0.12                            | 0.36                             | 30,000   | 1,600              | 0.08                            | 0.16                             | 30,000   | 1,600              | 0.09                            | 0.18                             | 22,000  | 1,600              | 0.09                            | 0.13                             |
| 2010-0150     |                          | 1.5                | 30,000                             | 2,000              | 0.12                            | 0.36                             | 30,000   | 1,600              | 0.08                            | 0.16                             | 30,000   | 1,500              | 0.09                            | 0.18                             | 22,000  | 1,600              | 0.09                            | 0.13                             |
| 2010-0250     |                          | 2.5                | 30,000                             | 1,700              | 0.09                            | 0.27                             | 24,000   | 1,400              | 0.06                            | 0.12                             | 30,000   | 1,300              | 0.075                           | 0.15                             | 21,500  | 1,300              | 0.075                           | 0.1                              |
| 2011-0160     | R0.55                    | 1.6                | 30,000                             | 2,000              | 0.12                            | 0.36                             | 30,000   | 1,600              | 0.08                            | 0.16                             | 30,000   | 1,600              | 0.09                            | 0.18                             | 20,000  | 1,600              | 0.09                            | 0.13                             |
| 2012-0180     | R0.6                     | 1.8                | 30,000                             | 2,000              | 0.13                            | 0.39                             | 30,000   | 1,600              | 0.09                            | 0.18                             | 30,000   | 1,600              | 0.1                             | 0.2                              | 18,000  | 1,600              | 0.1                             | 0.15                             |
| 2013-0190     | R0.65                    | 1.9                | 30,000                             | 2,000              | 0.13                            | 0.39                             | 30,000   | 1,600              | 0.09                            | 0.18                             | 30,000   | 1,700              | 0.1                             | 0.2                              | 18,000  | 1,500              | 0.1                             | 0.15                             |
| 2014-0210     | R0.7                     | 2.1                | 30,000                             | 2,000              | 0.14                            | 0.42                             | 30,000   | 1,500              | 0.1                             | 0.2                              | 30,000   | 1,700              | 0.11                            | 0.2                              | 18,000  | 1,500              | 0.11                            | 0.16                             |
| 2015-0150(-6) | R0.75                    | 1.5                | 30,000                             | 2,000              | 0.15                            | 0.45                             | 30,000   | 1,600              | 0.12                            | 0.24                             | 30,000   | 1,700              | 0.12                            | 0.24                             | 18,000  | 1,500              | 0.12                            | 0.18                             |
| 2015-0200     |                          | 2                  | 30,000                             | 2,000              | 0.15                            | 0.45                             | 30,000   | 1,600              | 0.12                            | 0.24                             | 30,000   | 1,700              | 0.12                            | 0.24                             | 18,000  | 1,500              | 0.12                            | 0.18                             |
| 2015-0225     |                          | 2.25               | 30,000                             | 2,000              | 0.15                            | 0.45                             | 30,000   | 1,600              | 0.12                            | 0.24                             | 30,000   | 1,700              | 0.12                            | 0.24                             | 18,000  | 1,500              | 0.12                            | 0.18                             |
| 2015-0400     |                          | 4                  | 30,000                             | 1,800              | 0.12                            | 0.36                             | 23,000   | 1,200              | 0.08                            | 0.16                             | 30,000   | 1,400              | 0.1                             | 0.2                              | 15,000  | 1,200              | 0.09                            | 0.13                             |
| 2016-0240     | R0.8                     | 2.4                | 30,000                             | 2,000              | 0.16                            | 0.48                             | 30,000   | 1,600              | 0.12                            | 0.24                             | 30,000   | 1,800              | 0.12                            | 0.36                             | 18,000  | 1,400              | 0.1                             | 0.2                              |
| 2017-0250     | R0.85                    | 2.5                | 30,000                             | 2,000              | 0.17                            | 0.51                             | 30,000   | 1,700              | 0.14                            | 0.28                             | 30,000   | 1,800              | 0.14                            | 0.42                             | 18,000  | 1,400              | 0.12                            | 0.24                             |
| 2018-0270     | R0.9                     | 2.7                | 30,000                             | 2,000              | 0.18                            | 0.54                             | 30,000   | 1,800              | 0.16                            | 0.32                             | 30,000   | 1,900              | 0.16                            | 0.48                             | 16,000  | 1,300              | 0.14                            | 0.28                             |
| 2019-0280     | R0.95                    | 2.8                | 30,000                             | 2,000              | 0.19                            | 0.57                             | 30,000   | 1,900              | 0.18                            | 0.36                             | 30,000   | 1,900              | 0.18                            | 0.54                             | 16,000  | 1,300              | 0.16                            | 0.32                             |
| 2020-0200(-6) | R1                       | 2                  | 30,000                             | 2,000              | 0.2                             | 0.6                              | 30,000   | 2,000              | 0.21                            | 0.42                             | 30,000   | 2,000              | 0.2                             | 0.6                              | 16,000  | 1,300              | 0.17                            | 0.5                              |
| 2020-0300     |                          | 3                  | 30,000                             | 2,000              | 0.2                             | 0.6                              | 30,000   | 2,000              | 0.21                            | 0.42                             | 30,000   | 2,000              | 0.2                             | 0.6                              | 16,000  | 1,300              | 0.17                            | 0.5                              |
| 2020-0600     |                          | 6                  | 30,000                             | 2,000              | 0.2                             | 0.6                              | 30,000   | 2,000              | 0.14                            | 0.42                             | 30,000   | 2,000              | 0.13                            | 0.45                             | 10,800  | 850                | 0.1                             | 0.4                              |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

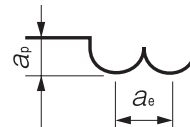


## Milling Conditions for CSEB

| WORK MATERIAL  |                          | COPPER / ALUMINUM ALLOYS |                                    |                    |                        |                         | CARBON STEELS / ALLOY STEELS<br>S45C / S50C / SK / SCM<br>(~325HB) |                    |                        |                         | PREHARDENED STEELS<br>NAK80 / STAVAX / HPM38<br>(30~45HRC) |                    |                        |                         | HARDENED STEELS<br>STAVAX / HPM38 / SKD61<br>(45~55HRC) |                    |                        |                         |
|----------------|--------------------------|--------------------------|------------------------------------|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|---|--------------------|------------------------|-------------------------|
| Model Number   | Radius of Ball Nose (mm) | Length of Cut (mm)       | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                                 | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                      | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2025-0250 (-6) | R1.25                    | 2.5                      | 27,000                             | 2,300              | 0.28                   | 0.75                    | 27,000   | 2,300              | 0.25                   | 0.5                     | 27,000   | 2,300              | 0.25                   | 0.75                    | 13,000  | 1,100              | 0.21                   | 0.63                    |
| 2025-0375      |                          | 3.75                     | 27,000                             | 2,300              | 0.28                   | 0.75                    | 27,000   | 2,300              | 0.25                   | 0.5                     | 27,000   | 2,300              | 0.25                   | 0.75                    | 13,000  | 1,100              | 0.21                   | 0.63                    |
| 2025-0600      | R1.5                     | 6                        | 25,000                             | 2,100              | 0.26                   | 0.67                    | 25,000   | 2,100              | 0.23                   | 0.46                    | 24,000   | 2,000              | 0.2                    | 0.65                    | 11,000  | 930                | 0.14                   | 0.44                    |
| 2030-0300      |                          | 3                        | 24,000                             | 2,500              | 0.32                   | 0.9                     | 24,000   | 2,500              | 0.32                   | 0.9                     | 24,000   | 2,500              | 0.3                    | 0.9                     | 14,000  | 1,400              | 0.25                   | 0.76                    |
| 2030-0450      | R1.5                     | 4.5                      | 24,000                             | 2,500              | 0.32                   | 0.9                     | 24,000   | 2,500              | 0.32                   | 0.9                     | 24,000   | 2,500              | 0.3                    | 0.9                     | 14,000  | 1,400              | 0.25                   | 0.76                    |
| 2030-0800      |                          | 8                        | 22,000                             | 2,300              | 0.28                   | 0.7                     | 22,000   | 2,300              | 0.28                   | 0.7                     | 20,000   | 2,000              | 0.2                    | 0.65                    | 10,700  | 1,000              | 0.18                   | 0.54                    |
| 2035-0520      | R1.75                    | 5.2                      | 24,000                             | 2,700              | 0.35                   | 1                       | 24,000   | 2,700              | 0.35                   | 1                       | 21,000   | 2,400              | 0.35                   | 1                       | 12,000  | 1,700              | 0.3                    | 0.9                     |
| 2040-0400      | R2                       | 4                        | 24,000                             | 2,900              | 0.4                    | 1.2                     | 24,000   | 2,900              | 0.4                    | 1.2                     | 18,000   | 2,400              | 0.4                    | 1.2                     | 11,000  | 2,000              | 0.34                   | 1                       |
| 2040-0600 (-4) |                          | 6                        | 24,000                             | 2,900              | 0.4                    | 1.2                     | 24,000   | 2,900              | 0.4                    | 1.2                     | 18,000   | 2,400              | 0.4                    | 1.2                     | 11,000  | 2,000              | 0.34                   | 1                       |
| 2040-0800      |                          | 8                        | 24,000                             | 2,900              | 0.4                    | 1.2                     | 24,000   | 2,900              | 0.4                    | 1.2                     | 18,000   | 2,400              | 0.4                    | 1.2                     | 11,000  | 2,000              | 0.34                   | 1                       |
| 2045-0670      | R2.25                    | 6.7                      | 21,000                             | 3,000              | 0.45                   | 1.3                     | 21,000   | 3,000              | 0.45                   | 1.3                     | 16,000   | 2,400              | 0.42                   | 1.2                     | 10,000  | 1,900              | 0.38                   | 1.1                     |
| 2050-0500      | R2.5                     | 5                        | 18,000                             | 3,000              | 0.5                    | 1.5                     | 18,000   | 3,000              | 0.5                    | 1.5                     | 13,000   | 2,400              | 0.45                   | 1.4                     | 9,000   | 1,800              | 0.42                   | 1.2                     |
| 2050-0750      |                          | 7.5                      | 18,000                             | 3,000              | 0.5                    | 1.5                     | 18,000   | 3,000              | 0.5                    | 1.5                     | 13,000   | 2,400              | 0.45                   | 1.4                     | 9,000   | 1,800              | 0.42                   | 1.2                     |
| 2050-0800      |                          | 8                        | 18,000                             | 3,000              | 0.5                    | 1.5                     | 18,000   | 3,000              | 0.5                    | 1.5                     | 13,000   | 2,400              | 0.45                   | 1.4                     | 9,000   | 1,800              | 0.42                   | 1.2                     |
| 2050-1200      |                          | 12                       | 18,000                             | 3,000              | 0.5                    | 1.5                     | 18,000   | 3,000              | 0.5                    | 1.5                     | 13,000   | 2,400              | 0.45                   | 1.4                     | 9,000   | 1,800              | 0.42                   | 1.2                     |
| 2055-0820      | R2.75                    | 8.2                      | 17,000                             | 3,000              | 0.55                   | 1.6                     | 17,000   | 3,000              | 0.55                   | 1.6                     | 12,000   | 2,400              | 0.5                    | 1.5                     | 8,500   | 1,800              | 0.45                   | 1.3                     |
| 2060-0600      | R3                       | 6                        | 16,000                             | 3,100              | 0.6                    | 1.8                     | 16,000   | 3,100              | 0.6                    | 1.8                     | 11,000   | 2,310              | 0.55                   | 1.7                     | 7,500   | 1,800              | 0.5                    | 1.5                     |
| 2060-0900      |                          | 9                        | 16,000                             | 3,100              | 0.6                    | 1.8                     | 16,000   | 3,100              | 0.6                    | 1.8                     | 11,000   | 2,310              | 0.55                   | 1.7                     | 7,500   | 1,800              | 0.5                    | 1.5                     |
| 2060-1200      |                          | 12                       | 16,000                             | 3,100              | 0.6                    | 1.8                     | 16,000   | 3,100              | 0.6                    | 1.8                     | 11,000   | 2,310              | 0.55                   | 1.7                     | 7,500   | 1,800              | 0.5                    | 1.5                     |
| 2065-0970      | R3.25                    | 9.7                      | 15,000                             | 3,100              | 0.65                   | 1.95                    | 15,000   | 3,100              | 0.65                   | 1.95                    | 10,000   | 2,200              | 0.59                   | 1.8                     | 7,000   | 1,800              | 0.54                   | 1.6                     |
| 2070-1050      | R3.5                     | 10.5                     | 14,000                             | 3,200              | 0.7                    | 2.1                     | 14,000   | 3,200              | 0.7                    | 2.1                     | 9,000  | 2,100              | 0.63                   | 1.9                     | 6,500   | 1,800              | 0.57                   | 1.7                     |
| 2075-1120      | R3.75                    | 11.2                     | 13,000                             | 3,300              | 0.75                   | 2.25                    | 13,000   | 3,300              | 0.75                   | 2.25                    | 8,200  | 2,000              | 0.67                   | 2                       | 6,000   | 1,800              | 0.6                    | 1.8                     |
| 2080-0800      | R4                       | 8                        | 12,000                             | 3,300              | 0.8                    | 2.4                     | 12,000   | 3,300              | 0.8                    | 2.4                     | 7,400  | 1,900              | 0.72                   | 2.2                     | 5,700   | 1,800              | 0.65                   | 2                       |
| 2080-1200      |                          | 12                       | 12,000                             | 3,300              | 0.8                    | 2.4                     | 12,000   | 3,300              | 0.8                    | 2.4                     | 7,400  | 1,900              | 0.72                   | 2.2                     | 5,700   | 1,800              | 0.65                   | 2                       |
| 2080-1400      |                          | 14                       | 12,000                             | 3,300              | 0.8                    | 2.4                     | 12,000   | 3,300              | 0.8                    | 2.4                     | 7,400  | 1,900              | 0.72                   | 2.2                     | 5,700   | 1,800              | 0.65                   | 2                       |
| 2085-1270      |                          | R4.25                    | 12.7                               | 12,000             | 3,300                  | 0.85                    | 2.55   | 12,000             | 3,300                  | 0.85                    | 2.55   | 6,800              | 1,800                  | 0.75                    | 2.3   | 5,400              | 1,700                  | 0.7                     |
| 2090-1350      | R4.5                     | 13.5                     | 11,000                             | 3,400              | 0.9                    | 2.7                     | 11,000   | 3,400              | 0.9                    | 2.7                     | 6,300  | 1,700              | 0.8                    | 2.4                     | 5,100   | 1,600              | 0.75                   | 2.2                     |
| 2100-1000      | R5                       | 10                       | 10,000                             | 3,500              | 1                      | 3                       | 10,000   | 3,500              | 1                      | 3                       | 5,200  | 1,650              | 0.9                    | 2.7                     | 4,600   | 1,500              | 0.85                   | 2.5                     |
| 2100-1500      |                          | 15                       | 10,000                             | 3,500              | 1                      | 3                       | 10,000   | 3,500              | 1                      | 3                       | 5,200  | 1,650              | 0.9                    | 2.7                     | 4,600   | 1,500              | 0.85                   | 2.5                     |
| 2100-1800      |                          | 18                       | 10,000                             | 3,500              | 1                      | 3                       | 10,000   | 3,500              | 1                      | 3                       | 5,200  | 1,650              | 0.9                    | 2.7                     | 4,600   | 1,500              | 0.85                   | 2.5                     |
| 2110-1650      | R5.5                     | 16.5                     | 9,000                              | 3,400              | 1.1                    | 3.3                     | 9,000  | 3,400              | 1.1                    | 3.3                     | 4,700  | 1,500              | 1                      | 3                       | 4,200   | 1,350              | 0.9                    | 2.7                     |
| 2120-1200      | R6                       | 12                       | 8,400                              | 3,300              | 1.2                    | 3.6                     | 8,400  | 3,300              | 1.2                    | 3.6                     | 4,300  | 1,350              | 1.1                    | 3.2                     | 3,800   | 1,250              | 1                      | 3                       |
| 2120-1800      |                          | 18                       | 8,400                              | 3,300              | 1.2                    | 3.6                     | 8,400  | 3,300              | 1.2                    | 3.6                     | 4,300  | 1,350              | 1.1                    | 3.2                     | 3,800   | 1,250              | 1                      | 3                       |
| 2120-2200      |                          | 22                       | 8,400                              | 3,300              | 1.2                    | 3.6                     | 8,400  | 3,300              | 1.2                    | 3.6                     | 4,300  | 1,350              | 1.1                    | 3.2                     | 3,800   | 1,250              | 1                      | 3                       |

## Note:

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machines maximum speed, or when the tool is chattering and heats up to a red color.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend wet coolant for Copper.

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.5~R6

# DCB

MG

DIA

35°

R ±0.01

Shank Dia 0/-0.005

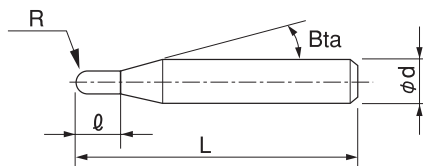
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           | ○               | ★        | ○      | ○        | ●                     |                 |                       |                  | ○                                     |

## Features

**Diamond coated 2 flute ball end mills for Graphite Electrode milling.**

**New diamond coating with a highly adhesive base layer offers excellent wear resistance and longer tool life.**



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 9 models

Unit (mm)

| Model Number | Radius of Ball Nose R | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|-----------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| DCB 2010     | R0.5                  | 5                    | 16°                   | 60               | 4                       | 16,000                   |
| DCB 2020     | R1                    | 10                   | 16°                   | 70               | 4                       | 17,000                   |
| DCB 2030     | R1.5                  | 15                   | 16°                   | 80               | 4                       | 21,000                   |
| DCB 2040     | R2                    | 20                   | —                     | 100              | 4                       | 24,000                   |
| DCB 2050     | R2.5                  | 20                   | —                     | 100              | 5                       | 28,000                   |
| DCB 2060     | R3                    | 30                   | —                     | 150              | 6                       | 41,500                   |
| DCB 2080     | R4                    | 40                   | —                     | 150              | 8                       | 45,000                   |
| DCB 2100     | R5                    | 50                   | —                     | 180              | 10                      | 57,500                   |
| DCB 2120     | R6                    | 55                   | —                     | 180              | 12                      | 87,500                   |

## Milling Conditions for DCB

| WORK MATERIAL |                          | GRAPHITE                           |                    |                        |                         |
|---------------|--------------------------|------------------------------------|--------------------|------------------------|-------------------------|
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2010          | R0.5                     | 10,000                             | 140                | 0.1                    | 0.3                     |
| 2020          | R1                       | 10,000                             | 300                | 0.2                    | 0.6                     |
| 2030          | R1.5                     | 10,000                             | 900                | 0.3                    | 0.9                     |
| 2040          | R2                       | 10,000                             | 900                | 0.4                    | 1.2                     |
| 2050          | R2.5                     | 10,000                             | 1,200              | 0.5                    | 1.5                     |
| 2060          | R3                       | 10,000                             | 1,460              | 0.6                    | 1.8                     |
| 2080          | R4                       | 7,500                              | 1,350              | 0.8                    | 2.4                     |
| 2100          | R5                       | 6,000                              | 1,440              | 1                      | 3                       |
| 2120          | R6                       | 5,000                              | 1,400              | 1.2                    | 3.6                     |

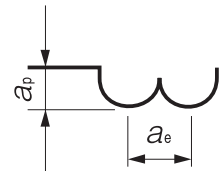
## ◆ High speed milling

| WORK MATERIAL |                          | GRAPHITE                           |                    |                        |                         |
|---------------|--------------------------|------------------------------------|--------------------|------------------------|-------------------------|
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2010          | R0.5                     | 50,000                             | 700                | 0.1                    | 0.3                     |
| 2020          | R1                       | 45,000                             | 1,350              | 0.2                    | 0.6                     |
| 2030          | R1.5                     | 30,000                             | 2,700              | 0.3                    | 0.9                     |
| 2040          | R2                       | 22,500                             | 2,025              | 0.4                    | 1.2                     |
| 2050          | R2.5                     | 18,000                             | 2,160              | 0.5                    | 1.5                     |
| 2060          | R3                       | 15,000                             | 2,190              | 0.6                    | 1.8                     |
| 2080          | R4                       | 11,500                             | 2,300              | 0.8                    | 2.4                     |
| 2100          | R5                       | 9,000                              | 2,340              | 1                      | 3                       |
| 2120          | R6                       | 7,500                              | 2,250              | 1.2                    | 3.6                     |

## Note:

- Use a milling machine dedicated for Graphite.
- Recommend air blow for Graphite.

For 3D milling / Finishing  
Milling Amount (mm)



DCB Series  
Aluminum:A7075  
Milling Video



DCB Series  
Graphite:TTK-5(80HS)  
Milling Video



φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.2~R6

# CGB2000



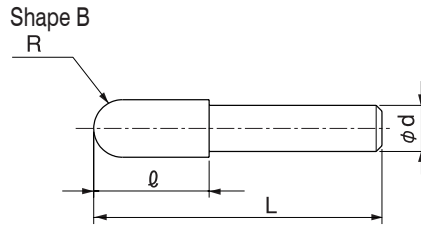
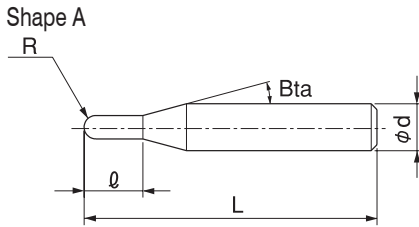
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           | ○               | ★        | ○      | ○        | ○                     |                 |                       |                  |                                       |

## Features

**Designed for milling Graphite.**  
**The chosen carbide grade offers excellent resistance to wear and abrasion.**  
**Refer to page 458 for 4 flute CGB.**

The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece. Actual measurement is necessary when using longer length of cut than the written length.



Total 15 models

Unit (mm)

| Model Number | Radius of Ball Nose R | Length of Cut ℓ | Shank Taper Angle Bta | Overall Length L | Shank Diameter φd | Shape | Suggested Retail Price ¥ |
|--------------|-----------------------|-----------------|-----------------------|------------------|-------------------|-------|--------------------------|
| CGB 2004     | R0.2                  | 0.8             | 16°                   | 60               | 4                 | A     | 11,000                   |
| CGB 2006     | R0.3                  | 1.2             | 16°                   | 60               | 4                 | A     | 11,000                   |
| CGB 2010     | R0.5                  | 5               | 16°                   | 60               | 4                 | A     | 11,000                   |
| CGB 2015     | R0.75                 | 5               | 16°                   | 60               | 4                 | A     | 11,000                   |
| CGB 2020     | R1                    | 10              | 16°                   | 70               | 4                 | A     | 12,700                   |
| CGB 2025     | R1.25                 | 10              | 16°                   | 70               | 4                 | A     | 12,700                   |
| CGB 2030     | R1.5                  | 15              | 16°                   | 80               | 4                 | A     | 15,600                   |
| CGB 2040     | R2                    | 20              | —                     | 100              | 4                 | A     | 18,600                   |
| CGB 2050     | R2.5                  | 20              | —                     | 100              | 5                 | A     | 18,900                   |
| CGB 2060     | R3                    | 30              | —                     | 150              | 6                 | A     | 21,420                   |
| CGB 2070     | R3.5                  | 30              | —                     | 150              | 6                 | B     | 24,050                   |
| CGB 2080     | R4                    | 40              | —                     | 150              | 8                 | A     | 27,170                   |
| CGB 2100     | R5                    | 50              | —                     | 180              | 10                | A     | 35,420                   |
| CGB 2110     | R5.5                  | 50              | —                     | 180              | 10                | B     | 38,060                   |
| CGB 2120     | R6                    | 55              | —                     | 200              | 12                | A     | 41,470                   |

## Milling Conditions for CGB (2 Flutes)

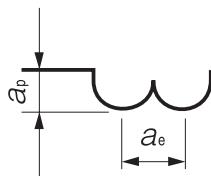
| WORK MATERIAL |                          | GRAPHITE                           |                    |                        |                         |
|---------------|--------------------------|------------------------------------|--------------------|------------------------|-------------------------|
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2004          | R0.2                     | 15,000                             | 60~90              | 0.12                   | 0.28                    |
| 2006          | R0.3                     | 15,000                             | 90~130             | 0.18                   | 0.42                    |
| 2010          | R0.5                     | 15,000                             | 150~220            | 0.3                    | 0.7                     |
| 2015          | R0.75                    | 15,000                             | 240~360            | 0.45                   | 1.05                    |
| 2020          | R1                       | 15,000                             | 300~450            | 0.6                    | 1.4                     |
| 2025          | R1.25                    | 15,000                             | 550~800            | 0.75                   | 1.75                    |
| 2030          | R1.5                     | 15,000                             | 900~1,350          | 0.9                    | 2.1                     |
| 2040          | R2                       | 15,000                             | 900~1,350          | 1.2                    | 2.8                     |
| 2050          | R2.5                     | 15,000                             | 1,200~1,800        | 1.5                    | 3.5                     |
| 2060          | R3                       | 15,000                             | 1,500~2,200        | 1.8                    | 4.2                     |
| 2070          | R3.5                     | 9,100                              | 1,500~2,200        | 2.1                    | 4.9                     |
| 2080          | R4                       | 8,000                              | 1,500~2,200        | 2.4                    | 5.6                     |
| 2100          | R5                       | 6,500                              | 1,500~2,200        | 3                      | 7                       |
| 2110          | R5.5                     | 6,000                              | 1,500~2,200        | 3.3                    | 7.7                     |
| 2120          | R6                       | 5,300                              | 1,500~2,200        | 3.6                    | 8.4                     |

For 3D milling / Finishing  
Milling Amount (mm)

$a_p = 0.3D$

$a_e = 0.7D$

D : Outside Diameter (mm)



Note:

· Use a milling machine dedicated for Graphite.

· Recommend air blow for Graphite.

## Graphite milling example



Work Size 150 × 150 × 150 mm

Cycle Time 2 h 18 min

**CGB 2000** Non-coated ball for Graphite milling



**CPRB** Non-coated long neck ball for Plastic milling



| Process       | Milling Method   | Tool |                                  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Allowance (mm) |
|---------------|------------------|------|----------------------------------|------------------------------------|--------------------|------------|------------|----------------|
| Roughing      | Offset           | CGB  | 2 Flute Ball R5                  | 6,400                              | 6,000              | 2.5        | 4          | 0.3            |
| Semi-roughing | Contour + Offset | CGB  | 2 Flute Ball R3                  | 11,000                             | 8,000              | 0.5        | 0.5        | 0.1            |
| Finishing     | Contour + Offset | CGB  | 2 Flute Ball R2                  | 16,000                             | 6,000              | 0.2        | 0.2        | 0              |
| Finishing     | Rest machining   | CPRB | 2 Flute Long Neck Ball R1 × EL22 | 30,000                             | 4,000              | 0.03       | 0.03       | 0              |

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.3~R6

**CFB**

Super  
MG

UT  
COAT

30°

R  
±0.005  
R0.3~R1.5

R  
±0.007  
R2~R3

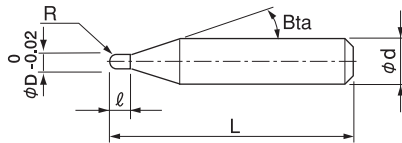
R  
±0.01  
R4~R6

Shank Dia  
0/-0.005

Variable  
Pitch  
R2~R6

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        | ○         | ●               |          | ○      |          | ●                     | ●               |                       |                  |                                       |



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 14 models

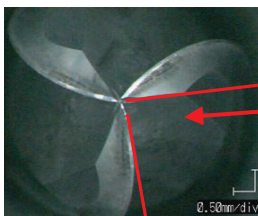
Unit (mm)

| Model Number    | Radius of Ball Nose R | Length of Cut ℓ | Shank Taper Angle Bta | Overall Length L | Shank Diameter φd | Suggested Retail Price ¥ |
|-----------------|-----------------------|-----------------|-----------------------|------------------|-------------------|--------------------------|
| CFB 3006-0090   | R0.3                  | 0.9             | 16°                   | 50               | 4                 | 6,890                    |
| CFB 3008-0120   | R0.4                  | 1.2             | 16°                   | 50               | 4                 | 6,720                    |
| CFB 3010-0150   | R0.5                  | 1.5             | 16°                   | 50               | 4                 | 6,230                    |
| CFB 3015-0225   | R0.75                 | 2.25            | 16°                   | 50               | 4                 | 6,890                    |
| CFB 3020-0300   | R1                    | 3               | 16°                   | 50               | 4                 | 6,720                    |
| CFB 3030-0450   | R1.5                  | 4.5             | 16°                   | 60               | 6                 | 6,890                    |
| CFB 3040-0600-4 | R2                    | 6               | —                     | 70               | 4                 | 6,560                    |
| CFB 3040-0600   |                       |                 | 16°                   | 70               | 6                 | 6,890                    |
| CFB 3050-0750   | R2.5                  | 7.5             | 16°                   | 80               | 6                 | 7,790                    |
| CFB 3060-0900   | R3                    | 9               | —                     | 80               | 6                 | 8,610                    |
| CFB 3080-1200   | R4                    | 12              | —                     | 90               | 8                 | 12,300                   |
| CFB 3080-1200LS |                       |                 | 120                   | 8                | 13,940            |                          |
| CFB 3100-1500   | R5                    | 15              | —                     | 100              | 10                | 16,320                   |
| CFB 3120-1800   | R6                    | 18              | —                     | 110              | 12                | 20,660                   |

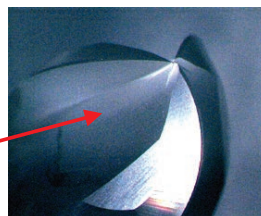
**Feature 1**  
High efficiency

**Big pocket** improves chip evacuation even with multi-flutes. Achieves **deep milling**.

Refer to P.447 Deep milling high efficiency roughing examples.



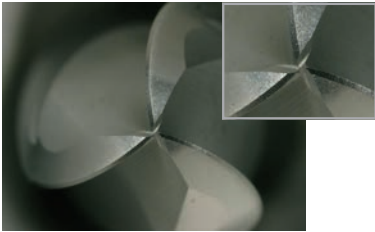
Wide angle



Deep tip pocket

## Feature 2 Tip slot effect

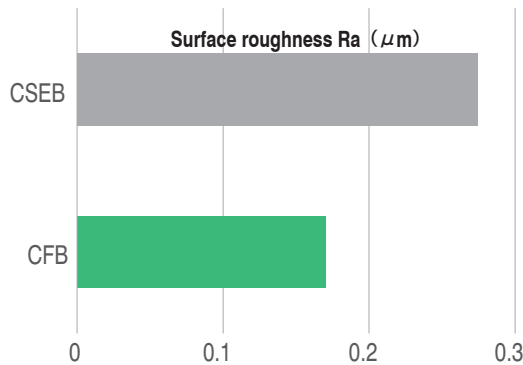
**Micro 3 slot design** at the tip prevents chip biting even at the peripheral speed zero point, providing **an excellent surface finish**.  
Micro 3 slot design is applied to R1 or above.



- ☆ **Radius accuracy** of the whole ball
- $\pm 0.005$  (R1 ~ R1.5)
  - $\pm 0.007$  (R2 ~ R3)
  - $\pm 0.01$  (R4 ~ R6)

## Comparison with 2 flutes (Ra) PXA30 30HRC

| Tool Diameter R3                              |        |
|---|--------|
| Spindle Speed (min <sup>-1</sup> )            | 14,000 |
| Feed Rate (mm/min)                            | 3,900  |
| $a_p$ (mm)                                    | 0.1    |
| $a_e$ (mm)                                    | 0.24   |
| Coolant<br>Water soluble<br>(Through Spindle) |        |



CFB enables highly efficient finishing with a wide pitch of  $a_e$  0.24.  
※ The Ra of CSEB and CFB are both the same at  $a_e$  0.12.



## Feature 3 Designed for a wide range of materials

Suited for various heat-resistant alloys including Titanium and Inconel due to **large pocket, variable pitch and high lubricity coating**.  
Tip slot design offers clean milling surfaces even for Copper, Aluminum and Acrylic.

| Copper, Acrylic                    |        |
|------------------------------------|--------|
| R3 Ball Finishing                  |        |
| Spindle Speed (min <sup>-1</sup> ) | 30,000 |
| Feed Rate (mm/min)                 | 4,000  |
| $a_p$ (mm)                         | 0.12   |
| $a_e$ (mm)                         | 0.12   |
| Coolant: Water soluble             |        |



**Copper C1100**  
55 × 50 × 23 mm  
Excellent surface roughness even on Copper that prone to chatter marks.



**Acrylic**  
55 × 50 × 23 mm  
Even Acrylic shows this high transparency without polishing.



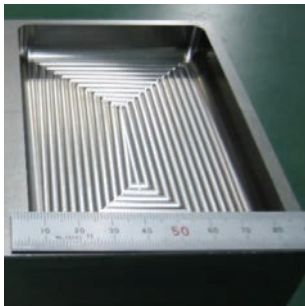
SUS304



Aluminum Alloys A7075



Titanium Alloys Ti-6Al-4V



CFB R3



· Coolant: Water soluble · Pocket size 55 × 50 × 23 mm

| Process        | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Cycle Time (min) |
|----------------|------------------------------------|--------------------|---------------------|---------------------|------------------|
| Roughing       | 9,000                              | 3,000              | 0.6                 | 3                   | 9.5              |
| Semi-finishing | 9,000                              | 3,000              | 0.7                 | 0.7                 | 4                |
| Finishing      | 20,000                             | 2,500              | 0.12                | 0.12                | 20.5             |
|                |                                    |                    |                     |                     | 34               |

CFB R3



· Coolant: Water soluble · Pocket size 55 × 50 × 23 mm

| Process        | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Cycle Time (min) |
|----------------|------------------------------------|--------------------|---------------------|---------------------|------------------|
| Roughing       | 12,000                             | 6,000              | 0.6                 | 3                   | 5                |
| Semi-finishing | 12,000                             | 6,000              | 0.7                 | 0.7                 | 2                |
| Finishing      | 30,000                             | 4,000              | 0.12                | 0.12                | 17               |
|                |                                    |                    |                     |                     | 24               |

CFB R5

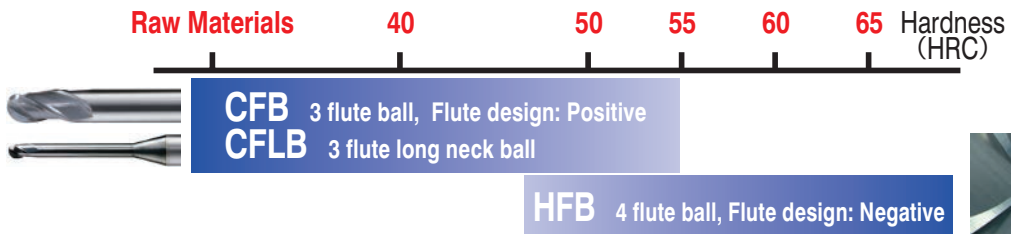


· Coolant: Water soluble · Pocket size 80 × 120 × 15 mm

| Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Cycle Time (min) |
|------------------------------------|--------------------|---------------------|---------------------|------------------|
| 3,900                              | 2,000              | 1                   | 3                   | 25               |

Dramatically high feed with Titanium Alloys.

3 series of tip slot ball



3 flute long neck ball CFLB series (P530) and 4 flute ball HFB series for hard materials (P452) are also available.



- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



# Milling Conditions for CFB

## ◆Roughing

| WORK MATERIAL  |                          | COPPER / ALUMINUM ALLOYS<br>C1100 / A5052 / A7075<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS / PREHARDENED STEELS<br>S45C / S50C / SKD / NAK<br>(~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>STAVAX / SKD61<br>(45~55HRC) |                    |                                 |                                  |
|----------------|--------------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Coolant        |                          | DRY (Unsuitable for Aluminum Alloys) / WET                    |                    |                                 |                                  | DRY / WET  |                    |                                 |                                  | DRY   |                    |                                 |                                  |
| Model Number   | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> )                            | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                                       | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 3006-0090      | R0.3                     | 30,000  | 1,000              | 0.03                            | 0.13                             | 30,000   | 1,000              | 0.03                            | 0.13                             | 30,000  | 700                | 0.03                            | 0.13                             |
| 3008-0120      | R0.4                     | 30,000  | 1,250              | 0.04                            | 0.17                             | 30,000   | 1,250              | 0.04                            | 0.17                             | 30,000  | 850                | 0.04                            | 0.17                             |
| 3010-0150      | R0.5                     | 30,000  | 1,500              | 0.05                            | 0.21                             | 30,000   | 1,500              | 0.05                            | 0.21                             | 30,000  | 1,000              | 0.05                            | 0.21                             |
| 3015-0225      | R0.75                    | 30,000  | 2,500              | 0.075                           | 0.32                             | 30,000   | 2,500              | 0.075                           | 0.32                             | 30,000  | 1,700              | 0.075                           | 0.32                             |
| 3020-0300      | R1                       | 30,000  | 3,200              | 0.2                             | 0.6                              | 30,000   | 3,200              | 0.2                             | 0.6                              | 30,000  | 2,500              | 0.2                             | 0.6                              |
| 3030-0450      | R1.5                     | 24,000  | 4,000              | 0.3                             | 0.9                              | 24,000   | 4,000              | 0.3                             | 0.9                              | 21,600  | 2,700              | 0.3                             | 0.9                              |
| 3040-0600      | R2                       | 18,000  | 4,000              | 0.4                             | 1.2                              | 18,000   | 4,000              | 0.4                             | 1.2                              | 16,200  | 2,700              | 0.4                             | 1.2                              |
| 3050-0750      | R2.5                     | 15,000  | 4,000              | 0.5                             | 1.5                              | 15,000   | 4,000              | 0.5                             | 1.5                              | 13,500  | 2,700              | 0.5                             | 1.5                              |
| 3060-0900      | R3                       | 12,000  | 4,000              | 0.6                             | 1.8                              | 12,000   | 4,000              | 0.6                             | 1.8                              | 10,800  | 2,700              | 0.6                             | 1.8                              |
| 3080-1200 (LS) | R4                       | 9,000   | 4,000              | 0.8                             | 2.4                              | 9,000  | 4,000              | 0.8                             | 2.4                              | 8,100   | 2,700              | 0.75                            | 2.1                              |
| 3100-1500      | R5                       | 7,200   | 4,000              | 1                               | 3                                | 7,200  | 4,000              | 1                               | 3                                | 6,500   | 2,700              | 0.85                            | 2.5                              |
| 3120-1800      | R6                       | 6,000   | 4,000              | 1.2                             | 3.6                              | 6,000  | 4,000              | 1.2                             | 3.6                              | 5,400   | 2,700              | 0.95                            | 3                                |

| WORK MATERIAL  |                          | TITANIUM ALLOYS / STAINLESS STEELS<br>Ti-6Al-4V / SUS |                    |                                 |                                  | HEAT RESISTANT ALLOYS<br>Inconel718 |                    |                                 |                                  |
|----------------|--------------------------|---|--------------------|---------------------------------|----------------------------------|-------------------------------------|--------------------|---------------------------------|----------------------------------|
| Coolant        |                          | DRY (Unsuitable for Aluminum Alloys) / WET            |                    |                                 |                                  | WET                                 |                    |                                 |                                  |
| Model Number   | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> )                    | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 3006-0090      | R0.3                     | 20,000  | 1,000              | 0.015                           | 0.09                             | 10,000                              | 250                | 0.015                           | 0.09                             |
| 3008-0120      | R0.4                     | 20,000  | 1,250              | 0.02                            | 0.12                             | 10,000                              | 310                | 0.02                            | 0.12                             |
| 3010-0150      | R0.5                     | 20,000  | 1,500              | 0.025                           | 0.15                             | 10,000                              | 375                | 0.025                           | 0.15                             |
| 3015-0225      | R0.75                    | 20,000  | 2,500              | 0.035                           | 0.22                             | 10,000                              | 625                | 0.035                           | 0.22                             |
| 3020-0300      | R1                       | 24,000  | 4,000              | 0.1                             | 0.4                              | 12,000                              | 1,000              | 0.1                             | 0.4                              |
| 3030-0450      | R1.5                     | 16,000  | 4,000              | 0.15                            | 0.65                             | 8,000                               | 1,000              | 0.15                            | 0.65                             |
| 3040-0600      | R2                       | 12,000  | 4,000              | 0.2                             | 0.85                             | 6,000                               | 1,000              | 0.2                             | 0.85                             |
| 3050-0750      | R2.5                     | 10,000  | 4,000              | 0.25                            | 1                                | 5,000                               | 1,000              | 0.25                            | 1                                |
| 3060-0900      | R3                       | 8,000   | 4,000              | 0.3                             | 1.3                              | 4,000                               | 1,000              | 0.3                             | 1.3                              |
| 3080-1200 (LS) | R4                       | 6,000   | 4,000              | 0.4                             | 1.7                              | 3,000                               | 900                | 0.35                            | 1.6                              |
| 3100-1500      | R5                       | 4,800   | 4,000              | 0.5                             | 2.1                              | 2,400                               | 800                | 0.4                             | 1.9                              |
| 3120-1800      | R6                       | 4,000   | 4,000              | 0.6                             | 2.6                              | 2,000                               | 800                | 0.45                            | 2.2                              |

Apply when a deep tool setting causes the toolholder to extend beyond the full shank diameter and over the taper angle. Use the table below to adjust the parameters when compensating for extended overhang on the straight type design.

| WORK MATERIAL   | COPPER / CARBON STEELS / ALUMINUM ALLOYS<br>S45C, S50C, A5052, A7075<br>(~225HB) |             |                            |                             | ALLOY STEELS / PREHARDENED STEELS<br>SKD / NAK<br>(~45HRC) |           |                            |                             | HARDENED STEELS<br>STAVAX / SKD61<br>(45~55HRC) |           |                            |                             |
|-----------------|--|-------------|----------------------------|-----------------------------|--|-----------|----------------------------|-----------------------------|---|-----------|----------------------------|-----------------------------|
| Overhang Length | Spindle Speed  | Feed Rate   | a <sub>p</sub> Axial Depth | a <sub>e</sub> Radial Depth | Spindle Speed  | Feed Rate | a <sub>p</sub> Axial Depth | a <sub>e</sub> Radial Depth | Spindle Speed                                   | Feed Rate | a <sub>p</sub> Axial Depth | a <sub>e</sub> Radial Depth |
| ~3D             | ×1   | ×1~1.5(※)   | ×1                         | ×1                          | ×1   | ×1        | ×1                         | ×1                          | ×1  | ×1        | ×1                         | ×1                          |
| 4D              | ×0.9   | ×0.9~1.2(※) | ×1                         | ×1                          | ×0.9   | ×0.9      | ×1                         | ×1                          | ×0.9  | ×0.9      | ×1                         | ×1                          |
| 5D              | ×0.75  | ×0.75       | ×1                         | ×1                          | ×0.75  | ×0.75     | ×0.9                       | ×0.9                        | ×0.75   | ×0.75     | ×0.85                      | ×0.9                        |
| 6D              | ×0.6   | ×0.6        | ×1                         | ×1                          | ×0.6   | ×0.6      | ×0.85                      | ×0.9                        | ×0.6  | ×0.6      | ×0.8                       | ×0.85                       |
| 7D              | ×0.45  | ×0.4        | ×0.95                      | ×0.95                       | ×0.45  | ×0.4      | ×0.8                       | ×0.85                       | ×0.45   | ×0.4      | ×0.7                       | ×0.8                        |
| 8D              | ×0.35  | ×0.3        | ×0.9                       | ×0.9                        | ×0.35  | ×0.3      | ×0.7                       | ×0.8                        | ×0.35   | ×0.3      | ×0.6                       | ×0.75                       |

| WORK MATERIAL   | TITANIUM ALLOYS / STAINLESS STEELS<br>Ti-6Al-4V / SUS |           |                            |                             | HEAT RESISTANT ALLOYS<br>Inconel718 |           |                            |                             |
|-----------------|---|-----------|----------------------------|-----------------------------|-------------------------------------|-----------|----------------------------|-----------------------------|
| Overhang Length | Spindle Speed   | Feed Rate | a <sub>p</sub> Axial Depth | a <sub>e</sub> Radial Depth | Spindle Speed                       | Feed Rate | a <sub>p</sub> Axial Depth | a <sub>e</sub> Radial Depth |
| ~3D             | ×1  | ×1        | ×1                         | ×1                          | ×1                                  | ×1        | ×1                         | ×1                          |
| 4D              | ×0.9  | ×0.9      | ×1                         | ×1                          | ×0.9                                | ×0.9      | ×1                         | ×1                          |
| 5D              | ×0.75   | ×0.75     | ×0.95                      | ×0.95                       | ×0.75                               | ×0.75     | ×0.85                      | ×0.9                        |
| 6D              | ×0.6  | ×0.6      | ×0.9                       | ×0.9                        | ×0.6                                | ×0.6      | ×0.8                       | ×0.85                       |
| 7D              | ×0.45   | ×0.4      | ×0.85                      | ×0.9                        | ×0.45                               | ×0.4      | ×0.7                       | ×0.8                        |
| 8D              | ×0.35   | ×0.3      | ×0.85                      | ×0.85                       | ×0.35                               | ×0.3      | ×0.6                       | ×0.75                       |

(※) For high efficiency milling, set the feed rate higher. For improved surface finish and/or longer tool life, reduce the feed rate.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball  
Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for CFB

◆Finishing (overhang length ~6D)

| WORK MATERIAL    |                          | COPPER / CARBON STEELS / ALUMINUM ALLOYS<br>S45C / S50C / A5052 / A7075<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS / HARDENED STEELS<br>SKD / NAK<br>(~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>STAVAX / SKD61<br>(45~55HRC) |                    |                                 |                                  |
|------------------|--------------------------|---|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Coolant          |                          | WET   |                    |                                 |                                  | DRY / OIL MIST / WET                                    |                    |                                 |                                  | DRY / OIL MIST                                  |                    |                                 |                                  |
| Model Number     | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| <b>3020-0300</b> | <b>R1</b>                | 53,000  | 4,000              | 0.05                            | 0.04                             | 45,000  | 3,400              | 0.05                            | 0.04                             | 36,800  | 2,200              | 0.05                            | 0.04                             |
| <b>3030-0450</b> | <b>R1.5</b>              | 41,200  | 4,200              | 0.06                            | 0.06                             | 35,000  | 3,500              | 0.06                            | 0.06                             | 28,600  | 2,300              | 0.06                            | 0.06                             |
| <b>3040-0600</b> | <b>R2</b>                | 29,400  | 4,400              | 0.08                            | 0.08                             | 24,000  | 3,700              | 0.08                            | 0.08                             | 20,400  | 2,400              | 0.08                            | 0.08                             |
| <b>3060-0900</b> | <b>R3</b>                | 17,600  | 4,600              | 0.1                             | 0.12                             | 14,000  | 3,900              | 0.1                             | 0.12                             | 12,300  | 2,600              | 0.1                             | 0.12                             |
| <b>3080-1200</b> | <b>R4</b>                | 14,600  | 4,600              | 0.1                             | 0.16                             | 12,400  | 3,900              | 0.1                             | 0.16                             | 10,200  | 2,600              | 0.1                             | 0.16                             |
| <b>3100-1500</b> | <b>R5</b>                | 11,700  | 4,700              | 0.1                             | 0.2                              | 9,900   | 4,000              | 0.1                             | 0.2                              | 8,200   | 2,600              | 0.1                             | 0.2                              |
| <b>3120-1800</b> | <b>R6</b>                | 8,800   | 4,800              | 0.1                             | 0.24                             | 7,400   | 4,000              | 0.1                             | 0.24                             | 6,200   | 2,700              | 0.1                             | 0.24                             |

| WORK MATERIAL    |                          | TITANIUM ALLOYS / STAINLESS STEELS<br>Ti-6Al-4V / SUS |                    |                                 |                                  | HEAT RESISTANT ALLOYS<br>Inconel718 |                    |                                 |                                  |
|------------------|--------------------------|---|--------------------|---------------------------------|----------------------------------|-------------------------------------|--------------------|---------------------------------|----------------------------------|
| Coolant          |                          | WET   |                    |                                 |                                  | WET                                 |                    |                                 |                                  |
| Model Number     | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> )                    | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| <b>3020-0300</b> | <b>R1</b>                | 44,200  | 2,700              | 0.05                            | 0.04                             | 22,100                              | 1,100              | 0.05                            | 0.04                             |
| <b>3030-0450</b> | <b>R1.5</b>              | 34,400  | 2,800              | 0.06                            | 0.06                             | 17,200                              | 1,100              | 0.06                            | 0.06                             |
| <b>3040-0600</b> | <b>R2</b>                | 24,600  | 3,000              | 0.08                            | 0.08                             | 12,300                              | 1,200              | 0.08                            | 0.08                             |
| <b>3060-0900</b> | <b>R3</b>                | 14,800  | 3,200              | 0.1                             | 0.12                             | 7,400                               | 1,300              | 0.1                             | 0.12                             |
| <b>3080-1200</b> | <b>R4</b>                | 12,300  | 3,200              | 0.1                             | 0.16                             | 6,200                               | 1,300              | 0.1                             | 0.16                             |
| <b>3100-1500</b> | <b>R5</b>                | 9,900   | 3,200              | 0.1                             | 0.2                              | 5,000                               | 1,300              | 0.1                             | 0.2                              |
| <b>3120-1800</b> | <b>R6</b>                | 7,500   | 3,300              | 0.1                             | 0.24                             | 3,800                               | 1,400              | 0.1                             | 0.24                             |

\*When finishing with an overhang of over 6 x D, fine adjustments are recommended.

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taber

Barrel

Spiral V Cutter

Drill

Technical Data

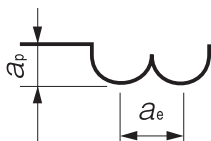
## Milling Conditions for CFB

### ◆ Deep and high efficiency roughing (3xD overhang for straight type)

This parameter is effective in using the machine that has low acceleration and applying complex milling path that repeats accelerating/braking frequently.

| WORK MATERIAL |                          | COPPER / CARBON STEELS / ALUMINUM ALLOYS<br>S45C / S50C / A5052 / A7075<br>(~225HB) |                    |                                 |                                  | ALLOY STEELS / HARDENED STEELS<br>SKD / NAK<br>(~45HRC) |                    |                                 |                                  |
|---------------|--------------------------|---|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Coolant       |                          | DRY (Unsuitable for Aluminum Alloys) / WET  |                    |                                 |                                  | DRY / WET   |                    |                                 |                                  |
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 3020-0300     | R1                       | 30,000  | 2,500              | 0.4                             | 0.8                              | 30,000  | 2,500              | 0.4                             | 0.8                              |
| 3030-0450     | R1.5                     | 20,000  | 2,500              | 0.6                             | 1.2                              | 20,000  | 2,500              | 0.6                             | 1.2                              |
| 3040-0600     | R2                       | 15,000  | 2,500              | 0.8                             | 1.6                              | 15,000  | 2,500              | 0.8                             | 1.6                              |
| 3060-0900     | R3                       | 10,000  | 2,500              | 1.2                             | 2.4                              | 10,000  | 2,500              | 1.2                             | 2.4                              |
| 3080-1200     | R4                       | 7,100   | 2,350              | 1.6                             | 3.2                              | 7,100   | 2,350              | 1.6                             | 3.2                              |
| 3100-1500     | R5                       | 5,400   | 2,250              | 2                               | 4                                | 5,400   | 2,250              | 2                               | 4                                |
| 3120-1800     | R6                       | 4,500   | 2,250              | 2.4                             | 4.8                              | 4,500   | 2,250              | 2.4                             | 4.8                              |

| WORK MATERIAL |                          | HARDENED STEELS<br>STAVAX / SKD61<br>(45~55HRC) |                    |                                 |                                  | TITANIUM ALLOYS / STAINLESS STEELS<br>Ti-6Al-4V / SUS |                    |                                 |                                  |
|---------------|--------------------------|---|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Coolant       |                          | DRY   |                    |                                 |                                  | WET   |                    |                                 |                                  |
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> )              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                    | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 3020-0300     | R1                       | 24,000  | 1,500              | 0.4                             | 0.8                              | 19,200  | 2,000              | 0.2                             | 0.6                              |
| 3030-0450     | R1.5                     | 16,000  | 1,500              | 0.6                             | 1.2                              | 12,800  | 2,000              | 0.3                             | 0.9                              |
| 3040-0600     | R2                       | 12,000  | 1,500              | 0.8                             | 1.6                              | 9,600   | 2,000              | 0.4                             | 1.2                              |
| 3060-0900     | R3                       | 8,000   | 1,500              | 1.2                             | 2.4                              | 6,400   | 2,000              | 0.6                             | 1.8                              |
| 3080-1200     | R4                       | 5,600   | 1,400              | 1.5                             | 3                                | 4,800   | 2,000              | 0.8                             | 2.4                              |
| 3100-1500     | R5                       | 4,300   | 1,300              | 1.7                             | 3.5                              | 3,900   | 2,000              | 1                               | 3                                |
| 3120-1800     | R6                       | 3,550   | 1,300              | 1.9                             | 4.2                              | 3,200   | 2,000              | 1.2                             | 3.6                              |



- Note:
- Fix the work piece firmly, and use a machine that has high rigidity and generates a low level of vibration especially under high efficient deep milling condition in roughing process.
  - Decrease the feed rate more than 50% from the milling parameters when slot milling.
  - Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machines maximum speed, or when the tool is chattering and heats up to a red color.
  - Decrease both spindle speed and feed rate 10% for slope milling.
  - Decrease both spindle speed and feed rate to meet required precision and to prevent the shank making contact with the work piece.
  - DRY: air blow, WET: water soluble or oil coolant.
  - A long overhang may cause tool deflection, leaving uncut material.

CFB Series  
SKD61 (47HRC)  
Milling Video



Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.3~R6

# DLC-CFB



R0.3~R1.5

R2~R3

R4~R6

R2~R6

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        | ★         |                 |          | ○      | ○        |                       |                 |                       |                  |                                       |

## Features

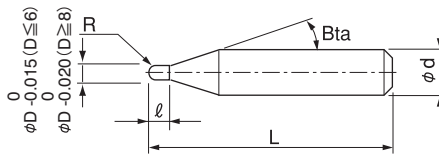
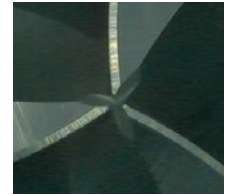
Achieves dramatically higher feed rates with 3 flutes, shortening roughing time.

DLC coating offers excellent welding and wear resistance.

Offers highly efficient milling even for a slow-moving shape, with deep cut milling.

3 flute variable pitch design reduces chattering.

The 3 slots at the tip offers chip evacuation and improved surface finish. (Except R0.75 or below)



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 14 models

Unit (mm)

| Model Number        | Radius of Ball Nose R | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|---------------------|-----------------------|----------------------|-----------------------|------------------|-------------------------|--------------------------|
| DLC-CFB 3006-0090   | R0.3                  | 0.9                  | 16°                   | 50               | 4                       | 7,220                    |
| DLC-CFB 3008-0120   | R0.4                  | 1.2                  | 16°                   | 50               | 4                       | 7,040                    |
| DLC-CFB 3010-0150   | R0.5                  | 1.5                  | 16°                   | 50               | 4                       | 6,540                    |
| DLC-CFB 3015-0225   | R0.75                 | 2.25                 | 16°                   | 50               | 4                       | 7,220                    |
| DLC-CFB 3020-0300   | R1                    | 3                    | 16°                   | 50               | 4                       | 7,040                    |
| DLC-CFB 3030-0450   | R1.5                  | 4.5                  | 16°                   | 60               | 6                       | 7,220                    |
| DLC-CFB 3040-0600-4 | R2                    | 6                    | —                     | 70               | 4                       | 6,880                    |
| DLC-CFB 3040-0600   |                       |                      | 16°                   | 70               | 6                       | 7,220                    |
| DLC-CFB 3050-0750   | R2.5                  | 7.5                  | 16°                   | 80               | 6                       | 8,170                    |
| DLC-CFB 3060-0900   | R3                    | 9                    | —                     | 80               | 6                       | 9,030                    |
| DLC-CFB 3080-1200   | R4                    | 12                   | —                     | 90               | 8                       | 12,900                   |
| DLC-CFB 3080-1200LS |                       |                      | —                     | 120              | 8                       | 14,600                   |
| DLC-CFB 3100-1500   | R5                    | 15                   | —                     | 100              | 10                      | 17,100                   |
| DLC-CFB 3120-1800   | R6                    | 18                   | —                     | 110              | 12                      | 21,600                   |

# Milling Conditions for DLC-CFB

3 Flutes

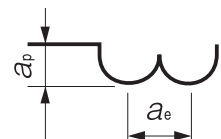
## ◆Roughing

| WORK MATERIAL |                          | ALUMINUM ALLOYS<br>A5052 etc.      |                    |                           |                            | ALUMINUM ALLOYS<br>A7075 etc.      |                    |                           |                            |
|---------------|--------------------------|------------------------------------|--------------------|---------------------------|----------------------------|------------------------------------|--------------------|---------------------------|----------------------------|
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 3006-0090     | R0.3                     | 30,000                             | 1,200              | 0.03                      | 0.13                       | 30,000                             | 1,000              | 0.03                      | 0.13                       |
| 3008-0120     | R0.4                     | 30,000                             | 1,500              | 0.04                      | 0.17                       | 30,000                             | 1,250              | 0.04                      | 0.17                       |
| 3010-0150     | R0.5                     | 30,000                             | 1,800              | 0.05                      | 0.21                       | 30,000                             | 1,500              | 0.05                      | 0.21                       |
| 3015-0225     | R0.75                    | 30,000                             | 3,000              | 0.075                     | 0.32                       | 30,000                             | 2,500              | 0.075                     | 0.32                       |
| 3020-0300     | R1                       | 30,000                             | 3,840              | 0.2                       | 0.6                        | 30,000                             | 3,200              | 0.2                       | 0.6                        |
| 3030-0450     | R1.5                     | 24,000                             | 4,800              | 0.3                       | 0.9                        | 24,000                             | 4,000              | 0.3                       | 0.9                        |
| 3040-0600(-4) | R2                       | 18,000                             | 4,800              | 0.4                       | 1.2                        | 18,000                             | 4,000              | 0.4                       | 1.2                        |
| 3050-0750     | R2.5                     | 15,000                             | 4,800              | 0.5                       | 1.5                        | 15,000                             | 4,000              | 0.5                       | 1.5                        |
| 3060-0900     | R3                       | 12,000                             | 4,800              | 0.6                       | 1.8                        | 12,000                             | 4,000              | 0.6                       | 1.8                        |
| 3080-1200(LS) | R4                       | 9,000                              | 4,800              | 0.8                       | 2.4                        | 9,000                              | 4,000              | 0.8                       | 2.4                        |
| 3100-1500     | R5                       | 7,200                              | 4,800              | 1                         | 3                          | 7,200                              | 4,000              | 1                         | 3                          |
| 3120-1800     | R6                       | 6,000                              | 4,800              | 1.2                       | 3.6                        | 6,000                              | 4,000              | 1.2                       | 3.6                        |

Apply when a deep tool setting causes the tool holder to extend beyond the full shank diameter and over the taper angle. Use the table below to adjust the parameters when compensating for extended overhang on the straight type design.

| WORK MATERIAL   | ALUMINUM ALLOYS A5052, A7075 |             |                      |                       |
|-----------------|------------------------------|-------------|----------------------|-----------------------|
| Overhang Length | Spindle Speed                | Feed Rate   | $a_p$<br>Axial Depth | $a_e$<br>Radial Depth |
| ~3D             | ×1                           | ×1~1.5(※)   | ×1                   | ×1                    |
| 4D              | ×0.9                         | ×0.9~1.2(※) | ×1                   | ×1                    |
| 5D              | ×0.75                        | ×0.75       | ×1                   | ×1                    |
| 6D              | ×0.6                         | ×0.6        | ×1                   | ×1                    |
| 7D              | ×0.45                        | ×0.4        | ×0.95                | ×0.95                 |
| 8D              | ×0.35                        | ×0.3        | ×0.9                 | ×0.9                  |

(※) For high efficiency milling, set the feed rate higher. For improved surface finish and/or longer tool life, reduce the feed rate.



- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for DLC-CFB

### ◆Finishing (overhang length ~6D)

| WORK MATERIAL    |                          | ALUMINUM ALLOYS<br>A5052           |                    |                                    |                                     | ALUMINUM ALLOYS<br>A7075           |                    |                                    |                                     |
|------------------|--------------------------|------------------------------------|--------------------|------------------------------------|-------------------------------------|------------------------------------|--------------------|------------------------------------|-------------------------------------|
| Model Number     | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) |
| <b>3020-0300</b> | <b>R1</b>                | 53,000                             | 4,800              | 0.05                               | 0.04                                | 53,000                             | 4,000              | 0.05                               | 0.04                                |
| <b>3030-0450</b> | <b>R1.5</b>              | 42,100                             | 5,040              | 0.06                               | 0.06                                | 42,100                             | 4,200              | 0.06                               | 0.06                                |
| <b>3040-0600</b> | <b>R2</b>                | 29,400                             | 5,280              | 0.08                               | 0.08                                | 29,400                             | 4,400              | 0.08                               | 0.08                                |
| <b>3060-0900</b> | <b>R3</b>                | 17,600                             | 5,520              | 0.1                                | 0.12                                | 17,600                             | 4,600              | 0.1                                | 0.12                                |
| <b>3080-1200</b> | <b>R4</b>                | 14,600                             | 5,520              | 0.1                                | 0.2                                 | 14,600                             | 4,600              | 0.1                                | 0.2                                 |
| <b>3100-1500</b> | <b>R5</b>                | 11,700                             | 5,640              | 0.1                                | 0.2                                 | 11,700                             | 4,700              | 0.1                                | 0.2                                 |
| <b>3120-1800</b> | <b>R6</b>                | 8,800                              | 5,760              | 0.1                                | 0.24                                | 8,800                              | 4,800              | 0.1                                | 0.24                                |

Adjustments are recommended when finishing with an overhang of over 6 x D.

### ◆Deep and high efficiency roughing (overhang length ~3D for straight type)

This parameter is effective in using the machine that has low acceleration and applying complex milling path that repeats accelerating/braking frequently.

| WORK MATERIAL    |                          | ALUMINUM ALLOYS<br>A5052           |                    |                                    |                                     | ALUMINUM ALLOYS<br>A7075           |                    |                                    |                                     |
|------------------|--------------------------|------------------------------------|--------------------|------------------------------------|-------------------------------------|------------------------------------|--------------------|------------------------------------|-------------------------------------|
| Model Number     | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub><br>Axial Depth (mm) | a <sub>e</sub><br>Radial Depth (mm) |
| <b>3020-0300</b> | <b>R1</b>                | 30,000                             | 3,000              | 0.4                                | 0.8                                 | 30,000                             | 2,500              | 0.4                                | 0.8                                 |
| <b>3030-0450</b> | <b>R1.5</b>              | 20,000                             | 3,000              | 0.6                                | 1.2                                 | 20,000                             | 2,500              | 0.6                                | 1.2                                 |
| <b>3040-0600</b> | <b>R2</b>                | 15,000                             | 3,000              | 0.8                                | 1.6                                 | 15,000                             | 2,500              | 0.8                                | 1.6                                 |
| <b>3060-0900</b> | <b>R3</b>                | 10,000                             | 3,000              | 1.2                                | 2.4                                 | 10,000                             | 2,500              | 1.2                                | 2.4                                 |
| <b>3080-1200</b> | <b>R4</b>                | 7,100                              | 2,820              | 1.6                                | 3.2                                 | 7,100                              | 2,350              | 1.6                                | 3.2                                 |
| <b>3100-1500</b> | <b>R5</b>                | 5,400                              | 2,700              | 2                                  | 4                                   | 5,400                              | 2,250              | 2                                  | 4                                   |
| <b>3120-1800</b> | <b>R6</b>                | 4,500                              | 2,700              | 2.4                                | 4.8                                 | 4,500                              | 2,250              | 2.4                                | 4.8                                 |

#### Note:

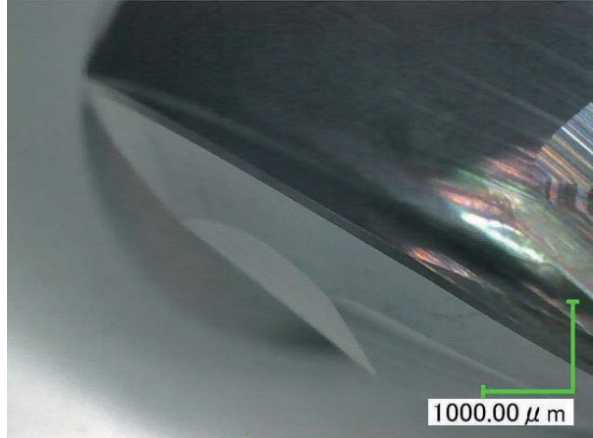
- Fix the work piece firmly, and use a machine that has high rigidity and generates a low level of vibration especially under high efficient deep milling condition in roughing process.
- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machines maximum speed, or when the tool is chattering and heats up to a red color.
- Decrease both spindle speed and feed rate 10% for slope milling.
- Decrease both spindle speed and feed rate to meet required precision and to prevent the shank making contact with the work piece.
- Recommend water soluble or oil coolant.
- A long overhang may cause tool deflection, leaving uncut material.

Mold Milling Example for Plastic Container  
DLC-CFB R4 × L12

A5052

3 Flutes

Tool after milling



**More tool life left**

Work Size : 130 x 105 x 95 mm  
Pocket Size :  $\phi$  80.5 x Depth 25 mm  
Coolant : Water Soluble (Through Spindle)

| No. | Milling Process | Tool              | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm)           | $a_e$ (mm) | Allowance (mm) | Milling Spot         | Cycle Time (h:min) |
|-----|-----------------|-------------------|------------------------------------|--------------------|----------------------|------------|----------------|----------------------|--------------------|
| 1   | Roughing        | DLC-CFB 3080-1200 | 8,100                              | 4,320              | 0.8                  | 2.4        | 0.01           | Pocket & Half Pocket | 1:05               |
| 2   | Finishing       |                   |                                    |                    | 0.0001 (Cusp Height) | 0.05       | 0              | Pocket               | 2:58               |
|     |                 |                   |                                    |                    |                      |            |                | Total                | 4:03               |

- $\phi$ 3mm Shank V Series
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- CBN Series
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- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Size R1~R6

**HFB**

Super  
MG

HARD  
MAX

40°

R  
±0.005  
R1~R1.5

R  
±0.007  
R2~R3

R  
±0.01  
R4~R6

Shank Dia  
0/-0.005

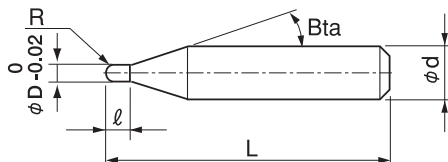
Patented in Japan, China, Taiwan, Korea, Germany, Switzerland, and Liechtenstein

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  | ●               | ●      | ●      | ●      | ●      |           |                 |          |        |          |                       |                 |                       |                  |                                       |

Features

Dramatically improved the milling efficiency. Maximum 27 times higher chip evacuation compared to conventional tool.  
 New ball tip design offers polish-less bottom surface finishing.  
 Affordable pricing.  
 Diameter Tolerance: 0/-0.02



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 8 models

Unit (mm)

| Model Number    | Radius of Ball Nose R | Length of Cut ℓ | Shank Taper Angle Bta | Overall Length L | Shank Diameter φd | Suggested Retail Price ¥ |
|-----------------|-----------------------|-----------------|-----------------------|------------------|-------------------|--------------------------|
| HFB 4020-0300   | R1                    | 3               | 16°                   | 50               | 4                 | 6,720                    |
| HFB 4020-0300-6 | R1                    | 3               | 16°                   | 50               | 6                 | 7,790                    |
| HFB 4030-0450   | R1.5                  | 4.5             | 16°                   | 60               | 6                 | 6,890                    |
| HFB 4040-0600   | R2                    | 6               | 16°                   | 70               | 6                 | 6,890                    |
| HFB 4060-0900   | R3                    | 9               | —                     | 80               | 6                 | 8,610                    |
| HFB 4080-1200   | R4                    | 12              | —                     | 90               | 8                 | 12,300                   |
| HFB 4100-1500   | R5                    | 15              | —                     | 100              | 10                | 16,320                   |
| HFB 4120-1800   | R6                    | 18              | —                     | 110              | 12                | 20,660                   |





Size R1~R6

HFB Short Shank

Patented in Japan, China, Taiwan, Korea, Germany, Switzerland, and Liechtenstein

# HFB-S

Super MG

HARD MAX

40°

R ±0.005  
R1~R1.5

R ±0.007  
R2~R3

R ±0.01  
R4~R6

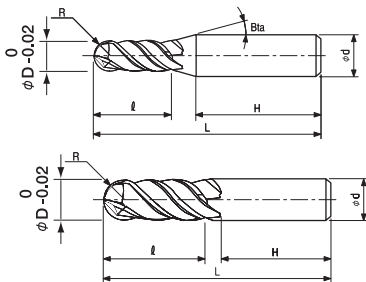
Shank Dia 0/-0.005

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  | ●               | ●      | ●      | ●      | ●      |           |                 |          |        |          |                       |                 |                       |                  |                                       |

## Features

Compatible with shrink-fit toolholder systems for high efficiency.  
A shorter overhang offers higher feed rates and precision.  
Diameter Tolerance: 0/-0.02



The shank taper angle and the shank length (H) shown are not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 7 models

Unit (mm)

| Model Number   | Radius of Ball Nose R | Length of Cut ℓ | Shank Taper Angle βta | Overall Length L | Shank Diameter φd | Shank Length H | Suggested Retail Price ¥ |
|----------------|-----------------------|-----------------|-----------------------|------------------|-------------------|----------------|--------------------------|
| HFB 4020-0300S | R1                    | 3               | 16°                   | 40               | 4                 | 31.0           | 6,720                    |
| HFB 4030-0450S | R1.5                  | 4.5             | 16°                   | 40               | 4                 | 30.5           | 6,890                    |
| HFB 4040-0600S | R2                    | 6               | 16°                   | 45               | 6                 | 32.5           | 6,890                    |
| HFB 4060-0900S | R3                    | 9               | —                     | 50               | 6                 | 34.5           | 8,610                    |
| HFB 4080-1200S | R4                    | 12              | —                     | 60               | 8                 | 40.5           | 12,300                   |
| HFB 4100-1500S | R5                    | 15              | —                     | 60               | 10                | 35.5           | 16,320                   |
| HFB 4120-1800S | R6                    | 18              | —                     | 60               | 12                | 31.5           | 20,660                   |

4 Flutes

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Milling Conditions for HFB / HFB-S

◆Roughing

| WORK MATERIAL |                          | PREHARDENED STEELS<br>NAK80 (35~45HRC)<br>Coolant: Water Soluble / Air Blow / Oil Mist |                    |                                 |                                  | HARDENED STEELS<br>STAVAX / SKD61 (45~55HRC)<br>Coolant: Air Blow / Oil Mist |                    |                                 |                                  |
|---------------|--------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4020-0300     | R1                       | 20,000   | 1,500              | 0.5                             | 0.8                              | 16,000   | 1,500              | 0.6                             | 0.9                              |
| 4030-0450     | R1.5                     | 16,000   | 2,000              | 0.6                             | 0.9                              | 10,500   | 1,500              | 0.9                             | 1.35                             |
| 4040-0600     | R2                       | 15,000   | 3,000              | 0.4                             | 0.8                              | 9,000  | 3,000              | 0.7                             | 1.4                              |
| 4060-0900     | R3                       | 9,000  | 2,500              | 0.5                             | 1                                | 8,000  | 3,500              | 0.6                             | 1.8                              |
| 4080-1200     | R4                       | CFB Series are Recommended   |                    |                                 |                                  | 6,200  | 3,000              | 0.75                            | 2.1                              |
| 4100-1500     | R5                       |  |                    |                                 |                                  | 4,500  | 2,700              | 0.85                            | 2.5                              |
| 4120-1800     | R6                       |  |                    |                                 |                                  | 3,750  | 2,700              | 0.95                            | 3                                |

| WORK MATERIAL |                          | HARDENED STEELS<br>YXR33 / SKD11 (55~60HRC)<br>Coolant: Air Blow / Oil Mist |                    |                                 |                                  | HARDENED STEELS<br>HAP10 / SKD11 / YXR7 (60~65HRC)<br>Coolant: Air Blow / Oil Mist |                    |                                 |                                  |
|---------------|--------------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4020-0300     | R1                       | 10,000  | 1,500              | 0.4                             | 0.8                              | 8,500  | 1,200              | 0.3                             | 0.7                              |
| 4030-0450     | R1.5                     | 6,500   | 1,500              | 0.6                             | 1.2                              | 5,500  | 1,200              | 0.5                             | 1.1                              |
| 4040-0600     | R2                       | 5,500   | 1,750              | 0.6                             | 1.2                              | 6,200  | 2,000              | 0.45                            | 1                                |
| 4060-0900     | R3                       | 4,500   | 1,750              | 0.6                             | 1.5                              | 5,000  | 2,000              | 0.45                            | 1.2                              |
| 4080-1200     | R4                       | 3,750   | 1,500              | 0.7                             | 1.75                             | 4,500  | 1,800              | 0.5                             | 1.4                              |
| 4100-1500     | R5                       | 3,000   | 1,500              | 0.75                            | 2                                | 3,600  | 1,800              | 0.6                             | 1.6                              |
| 4120-1800     | R6                       | 2,500   | 1,500              | 0.9                             | 2.4                              | 3,000  | 1,800              | 0.7                             | 1.8                              |

| WORK MATERIAL |                          | HARDENED STEELS<br>HAP72 (65~70HRC)<br>Coolant: Air Blow / Oil Mist |                    |                                 |                                  |
|---------------|--------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> )                                  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4020-0300     | R1                       | 10,500  | 750                | 0.2                             | 0.6                              |
| 4030-0450     | R1.5                     | 7,000   | 750                | 0.25                            | 0.8                              |
| 4040-0600     | R2                       | 7,500   | 1,200              | 0.2                             | 0.6                              |
| 4060-0900     | R3                       | 5,000   | 1,500              | 0.3                             | 0.9                              |
| 4080-1200     | R4                       | 4,000   | 1,500              | 0.3                             | 1                                |
| 4100-1500     | R5                       | 3,000   | 1,500              | 0.3                             | 1.2                              |
| 4120-1800     | R6                       | 2,500   | 1,300              | 0.3                             | 1.4                              |

- 3mm Shank V Series
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## Milling Conditions for HFB / HFB-S

Please adjust milling parameter according to overhang length, referring to the following table.

### Radius of Ball Nose R1 ( $\phi 4$ shank), R1.5

| Overhang Length            | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm)    | $a_e$ (mm)    |
|----------------------------|------------------------------------|--------------------|---------------|---------------|
| $\phi D \times 5$ or below | $\times 1$                         | $\times 1$         | $\times 1$    | $\times 1$    |
| $\sim \phi D \times 6$     | $\times 0.9$                       | $\times 0.9$       | $\times 0.95$ | $\times 0.95$ |
| $\sim \phi D \times 7$     | $\times 0.8$                       | $\times 0.8$       | $\times 0.9$  | $\times 0.95$ |
| $\sim \phi D \times 8$     | $\times 0.7$                       | $\times 0.7$       | $\times 0.85$ | $\times 0.9$  |
| $\sim \phi D \times 9$     | $\times 0.65$                      | $\times 0.6$       | $\times 0.8$  | $\times 0.9$  |
| $\sim \phi D \times 10$    | $\times 0.55$                      | $\times 0.5$       | $\times 0.75$ | $\times 0.85$ |

### Radius of Ball Nose R1 ( $\phi 6$ shank)

| Overhang Length         | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm)    | $a_e$ (mm)    |
|-------------------------|------------------------------------|--------------------|---------------|---------------|
| $\phi D \times 6$       | $\times 1$                         | $\times 1$         | $\times 1$    | $\times 1$    |
| $\sim \phi D \times 7$  | $\times 0.85$                      | $\times 0.9$       | $\times 0.95$ | $\times 0.95$ |
| $\sim \phi D \times 8$  | $\times 0.7$                       | $\times 0.8$       | $\times 0.9$  | $\times 0.9$  |
| $\sim \phi D \times 9$  | $\times 0.55$                      | $\times 0.75$      | $\times 0.85$ | $\times 0.9$  |
| $\sim \phi D \times 10$ | $\times 0.4$                       | $\times 0.65$      | $\times 0.8$  | $\times 0.85$ |

### Radius of Ball Nose R1.5 (Short shank)

| Overhang Length            | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm)   | $a_e$ (mm)    |
|----------------------------|------------------------------------|--------------------|--------------|---------------|
| $\phi D \times 5$ or below | $\times 1$                         | $\times 1$         | $\times 1$   | $\times 1$    |
| $\sim \phi D \times 6$     | $\times 0.55$                      | $\times 0.3$       | $\times 0.4$ | $\times 0.55$ |

### Radius of Ball Nose R2 or above

| Overhang Length            | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm)    | $a_e$ (mm)    |
|----------------------------|------------------------------------|--------------------|---------------|---------------|
| $\phi D \times 3$ or below | $\times 1$                         | $\times 1$         | $\times 1$    | $\times 1$    |
| $\sim \phi D \times 3.5$   | $\times 1$                         | $\times 0.85$      | $\times 0.85$ | $\times 0.9$  |
| $\sim \phi D \times 4$     | $\times 1$                         | $\times 0.8$       | $\times 0.7$  | $\times 0.8$  |
| $\sim \phi D \times 4.5$   | $\times 0.85$                      | $\times 0.55$      | $\times 0.6$  | $\times 0.75$ |
| $\sim \phi D \times 5$     | $\times 0.7$                       | $\times 0.35$      | $\times 0.6$  | $\times 0.75$ |
| $\sim \phi D \times 5.5$   | $\times 0.55$                      | $\times 0.25$      | $\times 0.55$ | $\times 0.7$  |
| $\sim \phi D \times 6$     | $\times 0.4$                       | $\times 0.15$      | $\times 0.5$  | $\times 0.7$  |

\* Refer to next page for finishing condition.

4 Flutes

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball

Taper

Taper  
Taper

Barrel

Barrel

Spiral  
V Cutter

Spiral  
V Cutter

Drill

Drill

Technical Data

Technical Data

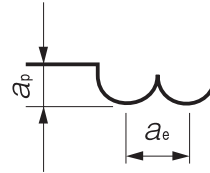
HFB Series  
SKD11 (60HRC)  
Milling Video



## Milling Conditions for HFB / HFB-S

### ◆Finishing (overhang length ~6D)

| WORK MATERIAL |                          | PREHARDENED STEELS / HARDENED STEELS<br>(35~60HRC)<br>Coolant: Oil Mist |                    |                        |                         |
|---------------|--------------------------|---|--------------------|------------------------|-------------------------|
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> )                                      | Feed Rate (mm/min) | Axial Depth $a_p$ (mm) | Radial Depth $a_e$ (mm) |
| 4020-0300     | R1                       | 26,000  | 2,000              | 0.02                   | 0.06                    |
| 4030-0450     | R1.5                     | 25,000  | 1,800              | 0.03                   | 0.07                    |
| 4040-0600     | R2                       | 22,500  | 1,500              | 0.04                   | 0.08                    |
| 4060-0900     | R3                       | 15,000  | 1,000              | 0.06                   | 0.12                    |
| 4080-1200     | R4                       | 11,250  | 750                | 0.08                   | 0.16                    |
| 4100-1500     | R5                       | 9,000   | 600                | 0.1                    | 0.2                     |
| 4120-1800     | R6                       | 7,500   | 500                | 0.12                   | 0.24                    |

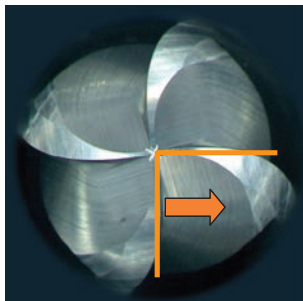


**Note:**

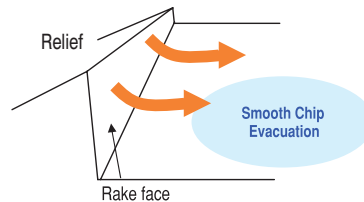
- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machines maximum speed, or when the tool is chattering and heats up to a red color.
- Adjustments are recommended when finishing with an overhang of over 6xD.
- Recommend air blow or oil mist. For materials under 45HRC, recommend water soluble coolant.

## Feature 1 Special Design Achieves Outstanding Chip Evacuation

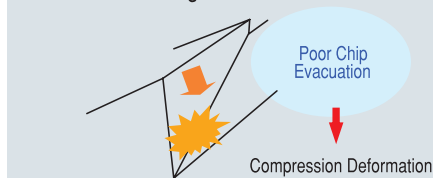
### HFB Design



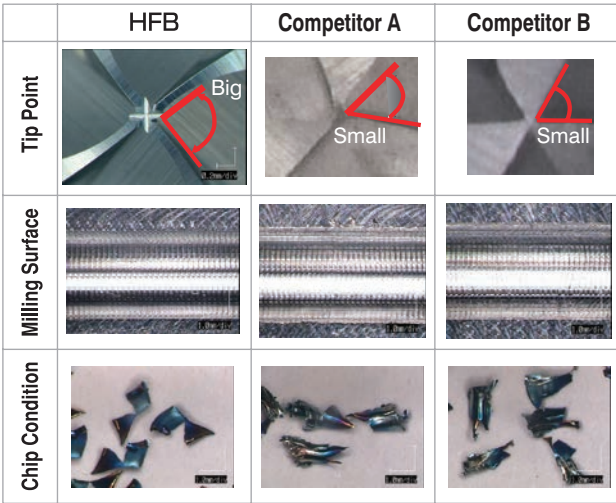
Flat (Non-rolled up) chip shape shows smooth chip evacuation.



### Conventional Design



Smooth chip evacuation achieves more stable milling.



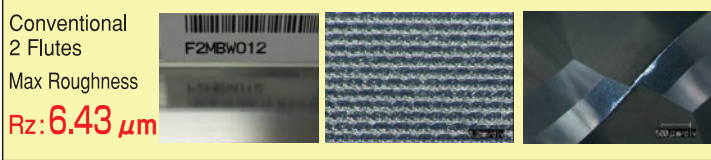
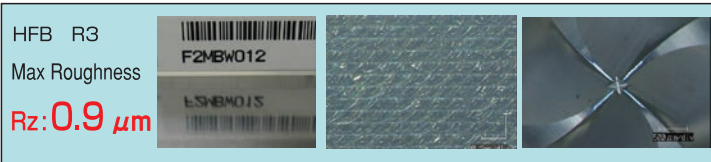
|                 |   |
|-----------------|---|
| Tool            | R2  |
| Work Material   | YXR33 (58HRC)                             |
| Spindle Speed   | 6,000 min <sup>-1</sup>                   |
| Feed Rate       | 2,400 mm/min<br>(Slotting : 1,200 mm/min) |
| $a_p$           | 1 mm (0.25D)                              |
| $a_e$           | 1 mm (0.25D)                              |
| Overhang Length | 15 mm                                     |
| Coolant         | Air Blow (Through Spindle)                |
| Pocket Size     | 100 × 20 × 6 mm<br>(X × Y × Z)            |
| Cycle Time      | 28.2 min                                  |

D : Outside Diameter

The large pocket design of the HFB promotes better chip evacuation and longer tool life when compared to a conventional design which shows premature damage.

## Feature 2 Polish-less Milling by 4 Tip Grooves

### STAVAX (53HRC) Milling Example: Flat Surface Finishing HFB (R3)

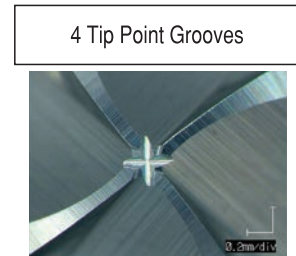
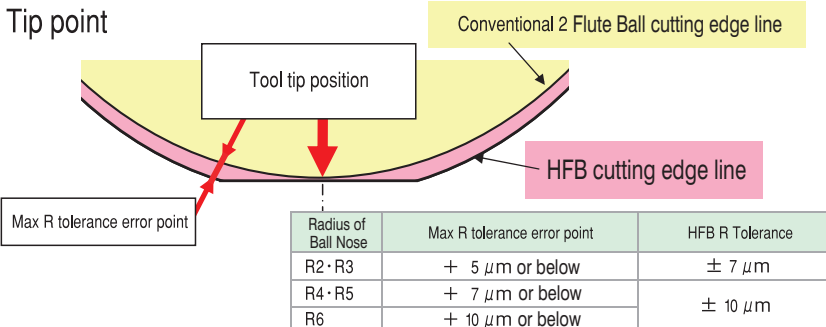


|               |                          |
|---------------|--------------------------|
| Spindle Speed | 12,800 min <sup>-1</sup> |
| Feed Rate     | 2,500 mm/min             |
| $a_p$         | 0.06 mm (0.01D)          |
| $a_e$         | 0.12 mm (0.02D)          |
| Coolant       | Oil Mist                 |

4 grooves on the tip point help surface finishing process. Max roughness values was 0.9  $\mu$ m on 1 hour testing.

The tool condition is better than conventional 2 Flutes.

### Tip point



Smooth chip evacuation reduces damage at the tip.

4 Flutes

$\varnothing$ 3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R2~R10

# CGB4000



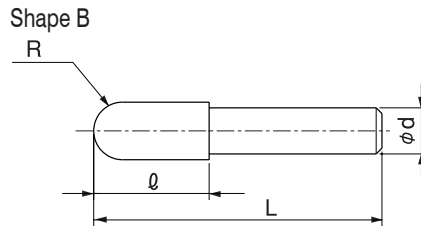
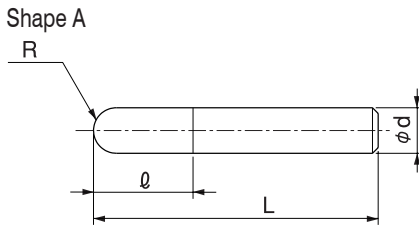
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material |                 |                    |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|---------------|-----------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels | Alloy Steels    | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|               |                 |                    | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| S45C<br>S55C  | SK / SCM<br>SUS | NAK<br>HPM         |                 |        |        |        |        |           | ○               | ★        | ○      | ○        | ○                     |                 |                       |                  |                                       |

## Features

Designed for milling Graphite.  
The chosen carbide grade offers excellent wear resistance.  
Refer to page 440 for 2 flute CGB.

Actual measurement is necessary when using longer length of cut than the written length.



Total 9 models

Unit (mm)

| Model Number | Radius of Ball Nose R | Length of Cut l | Overall Length L | Shank Diameter φd | Shape | Suggested Retail Price ¥ |
|--------------|-----------------------|-----------------|------------------|-------------------|-------|--------------------------|
| CGB 4040     | R2                    | 20              | 100              | 4                 | A     | 21,900                   |
| CGB 4050     | R2.5                  | 20              | 100              | 5                 | A     | 22,200                   |
| CGB 4060     | R3                    | 30              | 150              | 6                 | A     | 25,200                   |
| CGB 4070     | R3.5                  | 30              | 150              | 6                 | B     | 28,250                   |
| CGB 4080     | R4                    | 40              | 150              | 8                 | A     | 31,900                   |
| CGB 4100     | R5                    | 50              | 180              | 10                | A     | 39,380                   |
| CGB 4120     | R6                    | 55              | 200              | 12                | A     | 46,090                   |
| CGB 4160     | R8                    | 60              | 200              | 16                | A     | 65,010                   |
| CGB 4200     | R10                   | 60              | 250              | 20                | A     | 98,560                   |

## Milling Conditions for CGB (4 Flutes)

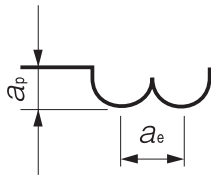
| WORK MATERIAL |                          | GRAPHITE                           |                    |                                 |                                  |
|---------------|--------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 4040          | R2                       | 15,000                             | 1,350~1,600        | 1.2                             | 2.8                              |
| 4050          | R2.5                     | 15,000                             | 1,350~1,600        | 1.5                             | 3.5                              |
| 4060          | R3                       | 15,000                             | 1,900~2,300        | 1.8                             | 4.2                              |
| 4070          | R3.5                     | 9,000                              | 1,900~2,300        | 2.1                             | 4.9                              |
| 4080          | R4                       | 8,000                              | 1,900~2,300        | 2.4                             | 5.6                              |
| 4100          | R5                       | 6,500                              | 2,000~2,500        | 3                               | 7                                |
| 4120          | R6                       | 5,300                              | 2,000~2,500        | 3.6                             | 8.4                              |
| 4160          | R8                       | 4,000                              | 2,000~2,500        | 4.8                             | 11.2                             |
| 4200          | R10                      | 3,200                              | 2,000~2,500        | 6                               | 14                               |

For 3D milling / Finishing  
Milling Amount (mm)

$$a_p = 0.3D$$

$$a_e = 0.7D$$

D : Outside Diameter (mm)



Note:

- Use a milling machine dedicated for Graphite.
- Recommend air blow for Graphite.

### Other series for Graphite milling

#### Square / Long Neck Square

(★ Highly Recommended ● Recommended ○ Suggested)

| Number of Flutes, Tool Type | Model Number | Appearance | Coating  | Size                   | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Hard Brittle (Non-Metallic) Materials | Page |
|-----------------------------|--------------|------------|----------|------------------------|-----------------|----------|--------|----------|-----------------------|---------------------------------------|------|
|                             |              |            |          |                        | ○               | ★        | ○      | ○        | ○                     | ●                                     |      |
| 4 flutes Square             | CGE          |            | Non-coat | $\phi 2 \sim \phi 20$  | ○               | ★        | ○      | ○        | ○                     |                                       | 236  |
| 2 flutes Square             | DCES 2000    |            | DIA      | $\phi 0.2 \sim \phi 6$ | ○               | ★        | ○      | ○        | ●                     | ○                                     | 188  |
| 4 flutes Square             | DCES 4000    |            | DIA      | $\phi 3 \sim \phi 10$  | ○               | ★        | ○      | ○        | ●                     | ○                                     | 234  |
| 2 flutes Long Neck Square   | DCLS         |            | DIA      | $\phi 0.4 \sim \phi 6$ | ○               | ★        | ○      | ○        | ●                     | ○                                     | 266  |

#### Long Neck Radius

|                           |       |  |     |                      |   |   |   |   |   |   |     |
|---------------------------|-------|--|-----|----------------------|---|---|---|---|---|---|-----|
| 4 flutes Long Neck Radius | DCLRS |  | DIA | $\phi 1 \sim \phi 6$ | ○ | ★ | ○ | ○ | ● | ○ | 396 |
|---------------------------|-------|--|-----|----------------------|---|---|---|---|---|---|-----|

#### Ball / Long Neck Ball / Taper Neck Ball

|                          |          |  |          |         |   |   |   |   |   |   |     |
|--------------------------|----------|--|----------|---------|---|---|---|---|---|---|-----|
| 2 flutes Ball            | CGB 2000 |  | Non-coat | R0.2~R6 | ○ | ★ | ○ | ○ | ○ |   | 440 |
| 4 flutes Ball            | CGB 4000 |  | Non-coat | R2~R10  | ○ | ★ | ○ | ○ | ○ |   | 458 |
| 2 flutes Ball            | DCB      |  | DIA      | R0.5~R6 | ○ | ★ | ○ | ○ | ● | ○ | 438 |
| 2 flutes Long Neck Ball  | DCLB     |  | DIA      | R0.2~R3 | ○ | ★ | ○ | ○ | ● | ○ | 512 |
| 2 flutes Taper Neck Ball | DCTNB    |  | DIA      | R0.5~R1 | ○ | ★ | ○ | ○ | ● | ○ | 556 |

4 Flutes

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

# 2 Flutes HMGCOAT for Hard Materials



Size **R0.05~R3**

# HGLB

Super  
MG

HMG  
COAT

30°

R  
±0.002  
R0.05~R0.075

R  
±0.003  
R0.1~R2

R  
±0.005  
R2.5~R3

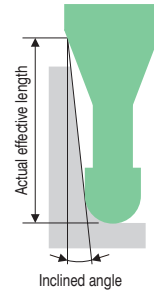
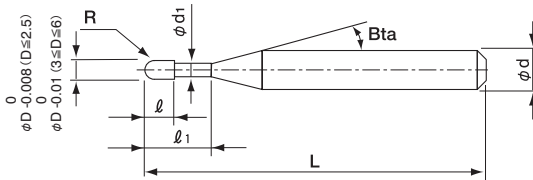
Shank Dia  
0/-0.004

Back Taper  
Geometry

~ Except for R0.4 or below.  
ℓ<sub>1</sub> / D ≤ 10

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |         |         |         |         |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|---------|---------|---------|---------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |         |         |         |         | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~ 50HRC         | ~ 55HRC | ~ 60HRC | ~ 65HRC | ~ 70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 | ○                                | ●               | ●       | ●       | ★       | ★       |           |                 |          |        |          |                       |                 |                       |                  |                                       |

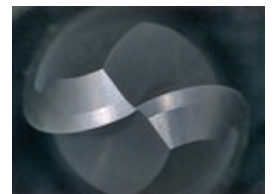


The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

New carbide materials with excellent wear resistance

Adopted new coating "HMGCOAT"

| Coating series          | COPPER | CARBON STEELS | PREHARDENED STEELS | HARDENED STEELS |          |          |          |          |
|-------------------------|--------|---------------|--------------------|-----------------|----------|----------|----------|----------|
|                         |        |               |                    | ~ 50 HRC        | ~ 55 HRC | ~ 60 HRC | ~ 65 HRC | ~ 70 HRC |
| <b>HMG COAT</b> HMGCOAT |        |               | ○                  | ○               | ○        | ●        | ★        | ★        |
| <b>HMW COAT</b> HMWCOAT | ○      | ○             | ●                  | ●               | ●        | ★        | ●        | ●        |
| <b>HARD MAX</b> HARDMAX | ○      | ○             | ●                  | ●               | ●        | ●        | ○        |          |



- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



## Super negative design specialized for high hardness of 60HRC or above

Long Neck Ball series for Steels

| Number of Flutes | Model Number   | Features                                   | Ball tip design | Copper | Carbon Steels | Pre hardened Steels | HARDENED STEELS |          |          |          |          | Alloy Steels | Aluminum Alloys | Plastics | Titanium/Heat Resistant Alloys | Page       |
|------------------|----------------|--|-----------------|--------|---------------|---------------------|-----------------|----------|----------|----------|----------|--------------|-----------------|----------|--------------------------------|------------|
|                  |                |  |                 |        |               |                     | ~ 50 HRC        | ~ 55 HRC | ~ 60 HRC | ~ 65 HRC | ~ 70 HRC |              |                 |          |                                |            |
| 2 Flutes         | HGLB           | Best suited for Hard Materials             | Super Negative  |        |               |                     | ○               | ●        | ●        | ●        | ★        | ★            |                 |          |                                | 460        |
|                  | HWLB           | For Hard Materials                         | Negative        |        | ○             | ○                   | ●               | ★        | ★        | ★        | ●        | ●            | ○               |          | ○                              | 470        |
|                  | HSLB<br>HSLB-S | For Hard Materials<br>Multi-purpose        | Negative        |        | ○             | ○                   | ●               | ●        | ●        | ●        | ○        |              | ○               |          | ○                              | 476<br>492 |
|                  | CSELB          | Multi-purpose<br>Excellent surface quality | Standard        |        | ●             | ●                   | ●               | ●        | ●        |          |          |              | ●               | ●        | ○                              | 496        |
| 3 Flutes         | CFLB           | Multi-purpose<br>Excellent surface quality | Positive        |        | ●             | ●                   | ●               | ●        | ●        |          |          | ●            | ●               | ○        | ●                              | 530        |

## High Precision Diameter Tolerance / Radius Accuracy / Shank Diameter Tolerance

HSLB Tolerance

| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy | Shank Diameter Tolerance |
|---------------------|--------------------|----------------------|--------------------------|
| R0.03 ~ R0.075      | 0/-0.01            | ±0.002               | <b>0/-0.005 (h5)</b>     |
| R0.1 ~ R3           | 0/-0.015           | ±0.005               |                          |

HGLB Tolerance

| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy | Shank Diameter Tolerance |
|---------------------|--------------------|----------------------|--------------------------|
| R0.05 ~ R0.075      | <b>0/-0.008</b>    | <b>±0.002</b>        | <b>0/-0.004 (h4)</b>     |
| R0.1 ~ R1.25        |                    | <b>±0.003</b>        |                          |
| R1.5 ~ R2           | <b>0/-0.01</b>     | ±0.005               |                          |
| R2.5 ~ R3           |                    |                      |                          |

Shank diameter tolerance h4!

Spur Gear

HAP72 (69HRC)



4 Flute / 6 Flute Radius End Mills for Hard Materials  
**HMERS**  
(P320)



Coolant : Air Blow  
(Through Spindle)  
Work size :  $\phi$  50.4 × Depth 11 mm

Ball End Mills for Hard Materials  
**HGB** (P422)



Long Neck Ball End Mills for Hard Materials  
**HGLB**



| Process        | Tool                   | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm)          | $a_e$ (mm) | Allowance (mm) | Cycle Time (h:m) | Milling Method                                 |
|----------------|------------------------|------------------------------------|--------------------|---------------------|------------|----------------|------------------|--|
| Roughing       | HGB R1.5               | 8,300                              | 1,140              | 0.12                | 0.55       | 0.02           | 1:41             | Roughing                                       |
| Roughing       | HGLB R1 × EL6          | 12,300                             | 1,800              | 0.06                | 0.3        | 0.02           | 0:06             | Rest machining                                 |
| Semi-Finishing |                        |                                    | 1,800              | 0.06                | 0.05       | 0.01           | 0:53             | Semi-Finishing                                 |
| Finishing      |                        |                                    | 900                | 0.00015 Cusp Height | —          | 0              | 0:09             | 45° surface / Finishing                        |
| Finishing      | HMERS $\phi$ 3 × CR0.1 | 8,600                              | 465                | 0.5                 | 1          | 0              | 0:02             | Above the gear teeth / Finishing               |
| Finishing      |                        |                                    | 1,500              | 0.0002 Cusp Height  | 1          | 0              | 0:01             | Bottom surface of cylindrical part / Finishing |
| Finishing      | HGLB R0.5 × EL6        | 20,000                             | 800                | 0.00015 Cusp Height | —          | 0              | 0:55             | Gear wall / Finishing                          |
| Finishing      |                        |                                    | 800                | 0.01                | 0.04       | 0              | 0:51             | Gear bottom / Finishing                        |
| Total          |                        |                                    |                    |                     |            |                | 4:38             |  |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Total 155 models

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |      |      |      |      |
|-----------------|-----------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|------|------|------|------|
|                 |                       |                           |                      |                          |                           |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°   | 3°   |      |      |
| HGLB 2001-002   | RO.05                 | 0.2                       | 0.08                 | 0.095                    | 16°                       | 45               | 4                       | 12,360                   | 0.22                                | 0.24  | 0.26  | 0.28 | 0.31 |      |      |
| HGLB 2001-003   |                       | 0.3                       |                      |                          |                           | 45               | 4                       | 12,360                   | 0.33                                | 0.36  | 0.38  | 0.40 | 0.44 |      |      |
| HGLB 2001-005   |                       | 0.5                       |                      |                          |                           | 45               | 4                       | 13,440                   | 0.55                                | 0.58  | 0.61  | 0.64 | 0.68 |      |      |
| HGLB 20015-003  | RO.075                | 0.3                       | 0.12                 | 0.14                     | 16°                       | 45               | 4                       | 14,400                   | 0.35                                | 0.37  | 0.39  | 0.41 | 0.44 |      |      |
| HGLB 20015-005  |                       | 0.5                       |                      |                          |                           | 45               | 4                       | 15,240                   | 0.56                                | 0.59  | 0.62  | 0.64 | 0.69 |      |      |
| HGLB 20015-0075 |                       | 0.75                      |                      |                          |                           | 45               | 4                       | 16,020                   | 0.83                                | 0.86  | 0.90  | 0.93 | 1.00 |      |      |
| HGLB 20015-010  |                       | 1                         |                      |                          |                           | 45               | 4                       | 16,020                   | 1.09                                | 1.13  | 1.17  | 1.21 | 1.30 |      |      |
| HGLB 2002-003   | RO.1                  | 0.3                       | 0.16                 | 0.19                     | 16°                       | 45               | 4                       | 8,640                    | 0.42                                | 0.44  | 0.46  | 0.48 | 0.52 |      |      |
| HGLB 2002-005   |                       | 0.5                       |                      |                          |                           | 45               | 4                       | 8,640                    | 0.63                                | 0.66  | 0.68  | 0.71 | 0.76 |      |      |
| HGLB 2002-0075  |                       | 0.75                      |                      |                          |                           | 45               | 4                       | 8,640                    | 0.89                                | 0.93  | 0.96  | 0.99 | 1.07 |      |      |
| HGLB 2002-010   |                       | 1                         |                      |                          |                           | 45               | 4                       | 8,640                    | 1.15                                | 1.20  | 1.24  | 1.28 | 1.37 |      |      |
| HGLB 2002-015   |                       | 1.5                       |                      |                          |                           | 45               | 4                       | 9,360                    | 1.66                                | 1.72  | 1.78  | 1.84 | 1.97 |      |      |
| HGLB 2002-020   |                       | 2                         |                      |                          |                           | 45               | 4                       | 10,440                   | 2.18                                | 2.25  | 2.33  | 2.41 | 2.58 |      |      |
| HGLB 2003-005   |                       | 0.5                       |                      |                          |                           | 0.24             | 0.29                    | 16°                      | 45                                  | 4     | 8,520 | 0.63 | 0.65 | 0.68 | 0.70 |
| HGLB 2003-0075  | 0.75                  | 45                        | 4                    | 8,520                    | 0.89                      |                  |                         |                          | 0.92                                | 0.96  | 0.99  | 1.05 |      |      |      |
| HGLB 2003-010   | 1                     | 45                        | 4                    | 8,520                    | 1.15                      |                  |                         |                          | 1.19                                | 1.23  | 1.27  | 1.36 |      |      |      |
| HGLB 2003-015   | 1.5                   | 45                        | 4                    | 9,120                    | 1.66                      |                  |                         |                          | 1.72                                | 1.77  | 1.83  | 1.96 |      |      |      |
| HGLB 2003-020   | 2                     | 45                        | 4                    | 9,120                    | 2.18                      |                  |                         |                          | 2.25                                | 2.32  | 2.40  | 2.57 |      |      |      |
| HGLB 2003-025   | 2.5                   | 45                        | 4                    | 9,360                    | 2.70                      |                  |                         |                          | 2.78                                | 2.87  | 2.97  | 3.18 |      |      |      |
| HGLB 2003-030   | 3                     | 45                        | 4                    | 9,360                    | 3.21                      |                  |                         |                          | 3.32                                | 3.42  | 3.54  | 3.80 |      |      |      |
| HGLB 2004-005   | 0.5                   | 0.32                      | 0.39                 | 16°                      | 45                        |                  |                         |                          | 4                                   | 5,880 | 0.63  | 0.65 | 0.67 | 0.70 | 0.74 |
| HGLB 2004-0075  | 0.75                  |                           |                      |                          | 45                        |                  |                         |                          | 4                                   | 5,880 | 0.89  | 0.92 | 0.95 | 0.98 | 1.04 |
| HGLB 2004-010   | 1                     |                           |                      |                          | 45                        | 4                | 5,880                   | 1.15                     | 1.19                                | 1.23  | 1.26  | 1.35 |      |      |      |
| HGLB 2004-010-6 | 1                     |                           |                      |                          | 50                        | 6                | 8,640                   | 1.15                     | 1.19                                | 1.23  | 1.26  | 1.35 |      |      |      |
| HGLB 2004-0125  | 1.25                  |                           |                      |                          | 45                        | 4                | 6,000                   | 1.40                     | 1.45                                | 1.49  | 1.54  | 1.64 |      |      |      |
| HGLB 2004-015   | 1.5                   |                           |                      |                          | 45                        | 4                | 6,000                   | 1.66                     | 1.71                                | 1.77  | 1.82  | 1.95 |      |      |      |
| HGLB 2004-015-6 | 1.5                   |                           |                      |                          | 50                        | 6                | 8,740                   | 1.66                     | 1.71                                | 1.77  | 1.82  | 1.95 |      |      |      |
| HGLB 2004-020   | 2                     |                           |                      |                          | 45                        | 4                | 6,120                   | 2.18                     | 2.25                                | 2.32  | 2.39  | 2.56 |      |      |      |
| HGLB 2004-020-6 | 2                     |                           |                      |                          | 50                        | 6                | 9,000                   | 2.18                     | 2.25                                | 2.32  | 2.39  | 2.56 |      |      |      |
| HGLB 2004-025   | 2.5                   |                           |                      |                          | 45                        | 4                | 6,360                   | 2.70                     | 2.78                                | 2.87  | 2.96  | 3.17 |      |      |      |
| HGLB 2004-025-6 | 2.5                   |                           |                      |                          | 50                        | 6                | 9,240                   | 2.70                     | 2.78                                | 2.87  | 2.96  | 3.17 |      |      |      |
| HGLB 2004-030   | 3                     |                           |                      |                          | 45                        | 4                | 6,720                   | 3.21                     | 3.31                                | 3.42  | 3.53  | 3.79 |      |      |      |
| HGLB 2004-030-6 | 3                     |                           |                      |                          | 50                        | 6                | 9,850                   | 3.21                     | 3.31                                | 3.42  | 3.53  | 3.79 |      |      |      |
| HGLB 2004-035   | 3.5                   |                           |                      |                          | 45                        | 4                | 7,320                   | 3.73                     | 3.84                                | 3.97  | 4.10  | 4.40 |      |      |      |
| HGLB 2004-040   | 4                     |                           |                      |                          | 45                        | 4                | 7,320                   | 4.24                     | 4.38                                | 4.52  | 4.67  | 5.01 |      |      |      |
| HGLB 2005-010   | 1                     |                           |                      |                          | 0.4                       | 0.49             | 16°                     | 45                       | 4                                   | 5,880 | 1.15  | 1.19 | 1.22 | 1.26 | 1.34 |
| HGLB 2005-015   | 1.5                   |                           |                      |                          |                           |                  |                         | 45                       | 4                                   | 5,880 | 1.65  | 1.71 | 1.76 | 1.82 | 1.94 |
| HGLB 2005-020   | 2                     |                           |                      |                          |                           |                  |                         | 45                       | 4                                   | 5,880 | 2.18  | 2.24 | 2.31 | 2.39 | 2.55 |
| HGLB 2005-025   | 2.5                   |                           |                      |                          |                           |                  |                         | 45                       | 4                                   | 5,880 | 2.69  | 2.78 | 2.86 | 2.96 | 3.16 |
| HGLB 2005-030   | 3                     | 45                        | 4                    | 5,880                    |                           |                  |                         | 3.21                     | 3.31                                | 3.41  | 3.53  | 3.77 |      |      |      |
| HGLB 2005-035   | 3.5                   | 45                        | 4                    | 5,880                    |                           |                  |                         | 3.73                     | 3.84                                | 3.96  | 4.09  | 4.39 |      |      |      |
| HGLB 2005-040   | 4                     | 45                        | 4                    | 5,880                    |                           |                  |                         | 4.24                     | 4.37                                | 4.51  | 4.66  | 5.00 |      |      |      |
| HGLB 2005-045   | 4.5                   | 45                        | 4                    | 6,000                    |                           |                  |                         | 4.76                     | 4.91                                | 5.06  | 5.23  | 5.61 |      |      |      |
| HGLB 2005-050   | 5                     | 45                        | 4                    | 6,000                    |                           |                  |                         | 5.27                     | 5.44                                | 5.61  | 5.80  | 6.22 |      |      |      |
| HGLB 2005-060   | 6                     | 45                        | 4                    | 6,120                    |                           |                  |                         | 6.30                     | 6.50                                | 6.71  | 6.94  | 7.45 |      |      |      |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi_d$ | Shank Taper Angle $\text{Bia}$ | Overall Length L | Shank Diameter $\phi_d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |       |       |      |      |      |      |
|-----------------|-----------------------|---------------------------|----------------------|------------------------|--------------------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|-------|-------|------|------|------|------|
|                 |                       |                           |                      |                        |                                |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°    | 3°    |      |      |      |      |
| HGLB 2006-010   | R0.3                  | 1                         | 0.48                 | 0.59                   | 16°                            | 45               | 4                       | 5,040                    | 1.14                                | 1.18  | 1.22  | 1.25  | 1.33  |      |      |      |      |
| HGLB 2006-015   |                       | 1.5                       |                      |                        |                                | 45               | 4                       | 4,560                    | 1.65                                | 1.71  | 1.76  | 1.81  | 1.93  |      |      |      |      |
| HGLB 2006-015-6 |                       | 1.5                       |                      |                        |                                | 50               | 6                       | 6,890                    | 1.65                                | 1.71  | 1.76  | 1.81  | 1.93  |      |      |      |      |
| HGLB 2006-020   |                       | 2                         |                      |                        |                                | 45               | 4                       | 4,560                    | 2.17                                | 2.24  | 2.31  | 2.38  | 2.54  |      |      |      |      |
| HGLB 2006-020-6 |                       | 2                         |                      |                        |                                | 50               | 6                       | 6,960                    | 2.17                                | 2.24  | 2.31  | 2.38  | 2.54  |      |      |      |      |
| HGLB 2006-025   |                       | 2.5                       |                      |                        |                                | 45               | 4                       | 4,680                    | 2.69                                | 2.77  | 2.86  | 2.95  | 3.15  |      |      |      |      |
| HGLB 2006-025-6 |                       | 2.5                       |                      |                        |                                | 50               | 6                       | 6,890                    | 2.69                                | 2.77  | 2.86  | 2.95  | 3.15  |      |      |      |      |
| HGLB 2006-030   |                       | 3                         |                      |                        |                                | 45               | 4                       | 4,680                    | 3.21                                | 3.31  | 3.41  | 3.52  | 3.76  |      |      |      |      |
| HGLB 2006-030-6 |                       | 3                         |                      |                        |                                | 50               | 6                       | 7,080                    | 3.21                                | 3.31  | 3.41  | 3.52  | 3.76  |      |      |      |      |
| HGLB 2006-035   |                       | 3.5                       |                      |                        |                                | 45               | 4                       | 4,800                    | 3.72                                | 3.84  | 3.96  | 4.09  | 4.38  |      |      |      |      |
| HGLB 2006-040   |                       | 4                         |                      |                        |                                | 45               | 4                       | 4,800                    | 4.24                                | 4.37  | 4.51  | 4.66  | 4.99  |      |      |      |      |
| HGLB 2006-045   |                       | 4.5                       |                      |                        |                                | 45               | 4                       | 4,800                    | 4.76                                | 4.90  | 5.06  | 5.23  | 5.60  |      |      |      |      |
| HGLB 2006-050   |                       | 5                         |                      |                        |                                | 45               | 4                       | 4,800                    | 5.27                                | 5.44  | 5.61  | 5.80  | 6.21  |      |      |      |      |
| HGLB 2006-055   |                       | 5.5                       |                      |                        |                                | 45               | 4                       | 4,800                    | 5.79                                | 5.97  | 6.16  | 6.37  | 6.82  |      |      |      |      |
| HGLB 2006-060   |                       | 6                         |                      |                        |                                | 45               | 4                       | 4,800                    | 6.30                                | 6.50  | 6.71  | 6.93  | 7.43  |      |      |      |      |
| HGLB 2006-080   |                       | 8                         |                      |                        |                                | 45               | 4                       | 6,360                    | 8.37                                | 8.63  | 8.91  | 9.21  | 9.88  |      |      |      |      |
| HGLB 2006-100   |                       | 10                        |                      |                        |                                | 45               | 4                       | 6,480                    | 10.43                               | 10.76 | 11.11 | 11.49 | 12.33 |      |      |      |      |
| HGLB 2008-020   |                       | R0.4                      |                      |                        |                                | 2                | 0.64                    | 0.79                     | 16°                                 | 45    | 4     | 4,560 | 2.17  | 2.23 | 2.30 | 2.37 | 2.52 |
| HGLB 2008-025   |                       |                           |                      |                        |                                | 2.5              |                         |                          |                                     | 45    | 4     | 4,800 | 2.69  | 2.77 | 2.85 | 2.94 | 3.13 |
| HGLB 2008-030   |                       |                           |                      |                        |                                | 3                |                         |                          |                                     | 45    | 4     | 4,800 | 3.21  | 3.30 | 3.40 | 3.50 | 3.74 |
| HGLB 2008-040   | 4                     |                           | 45                   | 4                      | 4,800                          | 4.24             |                         |                          |                                     | 4.36  | 4.50  | 4.64  | 4.97  |      |      |      |      |
| HGLB 2008-050   | 5                     |                           | 45                   | 4                      | 4,800                          | 5.27             |                         |                          |                                     | 5.43  | 5.60  | 5.78  | 6.19  |      |      |      |      |
| HGLB 2008-060   | 6                     |                           | 45                   | 4                      | 4,800                          | 6.30             |                         |                          |                                     | 6.49  | 6.70  | 6.92  | 7.41  |      |      |      |      |
| HGLB 2008-070   | 7                     |                           | 45                   | 4                      | 4,800                          | 7.33             |                         |                          |                                     | 7.56  | 7.80  | 8.06  | 8.64  |      |      |      |      |
| HGLB 2008-080   | 8                     |                           | 45                   | 4                      | 4,800                          | 8.36             |                         |                          |                                     | 8.62  | 8.90  | 9.20  | 9.86  |      |      |      |      |
| HGLB 2010-020   | 2                     |                           | 45                   | 4                      | 3,840                          | 2.18             |                         |                          |                                     | 2.24  | 2.30  | 2.36  | 2.51  |      |      |      |      |
| HGLB 2010-020-6 | 2                     |                           | 50                   | 6                      | 6,120                          | 2.18             |                         |                          |                                     | 2.24  | 2.30  | 2.36  | 2.51  |      |      |      |      |
| HGLB 2010-025   | 2.5                   | 45                        | 4                    | 3,840                  | 2.70                           | 2.77             | 2.85                    | 2.93                     | 3.12                                |       |       |       |       |      |      |      |      |
| HGLB 2010-030   | 3                     | 45                        | 4                    | 3,840                  | 3.21                           | 3.30             | 3.40                    | 3.50                     | 3.73                                |       |       |       |       |      |      |      |      |
| HGLB 2010-030-6 | 3                     | 50                        | 6                    | 6,120                  | 3.21                           | 3.30             | 3.40                    | 3.50                     | 3.73                                |       |       |       |       |      |      |      |      |
| HGLB 2010-040   | 4                     | 45                        | 4                    | 4,320                  | 4.24                           | 4.37             | 4.50                    | 4.64                     | 4.96                                |       |       |       |       |      |      |      |      |
| HGLB 2010-040-6 | 4                     | 50                        | 6                    | 6,720                  | 4.24                           | 4.37             | 4.50                    | 4.64                     | 4.96                                |       |       |       |       |      |      |      |      |
| HGLB 2010-050   | 5                     | 45                        | 4                    | 4,320                  | 5.28                           | 5.43             | 5.60                    | 5.78                     | 6.18                                |       |       |       |       |      |      |      |      |
| HGLB 2010-050-6 | 5                     | 50                        | 6                    | 6,720                  | 5.28                           | 5.43             | 5.60                    | 5.78                     | 6.18                                |       |       |       |       |      |      |      |      |
| HGLB 2010-060   | 6                     | 45                        | 4                    | 4,680                  | 6.31                           | 6.50             | 6.70                    | 6.92                     | 7.40                                |       |       |       |       |      |      |      |      |
| HGLB 2010-060-6 | 6                     | 50                        | 6                    | 7,080                  | 6.31                           | 6.50             | 6.70                    | 6.92                     | 7.40                                |       |       |       |       |      |      |      |      |
| HGLB 2010-070   | 7                     | 45                        | 4                    | 4,680                  | 7.34                           | 7.56             | 7.80                    | 8.06                     | 8.63                                |       |       |       |       |      |      |      |      |
| HGLB 2010-070-6 | 7                     | 50                        | 6                    | 7,080                  | 7.34                           | 7.56             | 7.80                    | 8.06                     | 8.63                                |       |       |       |       |      |      |      |      |
| HGLB 2010-080   | 8                     | 45                        | 4                    | 4,680                  | 8.37                           | 8.63             | 8.90                    | 9.20                     | 9.85                                |       |       |       |       |      |      |      |      |
| HGLB 2010-080-6 | 8                     | 50                        | 6                    | 7,080                  | 8.37                           | 8.63             | 8.90                    | 9.20                     | 9.85                                |       |       |       |       |      |      |      |      |
| HGLB 2010-100   | 10                    | 45                        | 4                    | 4,680                  | 10.43                          | 10.76            | 11.10                   | 11.47                    | 12.30                               |       |       |       |       |      |      |      |      |
| HGLB 2010-100-6 | 10                    | 50                        | 6                    | 7,080                  | 10.43                          | 10.76            | 11.10                   | 11.47                    | 12.30                               |       |       |       |       |      |      |      |      |
| HGLB 2010-120   | 12                    | 45                        | 4                    | 4,680                  | 12.50                          | 12.89            | 13.30                   | 13.75                    | 14.75                               |       |       |       |       |      |      |      |      |
| HGLB 2010-140   | 14                    | 45                        | 4                    | 5,400                  | 14.56                          | 15.02            | 15.51                   | 16.03                    | 17.19                               |       |       |       |       |      |      |      |      |
| HGLB 2010-160   | 16                    | 50                        | 4                    | 6,360                  | 16.62                          | 17.15            | 17.71                   | 18.31                    | 19.64                               |       |       |       |       |      |      |      |      |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## 2 Flutes HMGCOAT for Hard Materials

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |                 |                 |       |       |       |       |
|-----------------|-----------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|-----------------|-----------------|-------|-------|-------|-------|
|                 |                       |                           |                      |                          |                           |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°              | 3°              |       |       |       |       |
| HGLB 2015-030   | R0.75                 | 3                         | 1.2                  | 1.47                     | 16°                       | 45               | 4                       | 4,440                    | 3.10                                | 3.18  | 3.26  | 3.35            | 3.55            |       |       |       |       |
| HGLB 2015-030-6 |                       | 3                         |                      |                          |                           | 50               | 6                       | 7,130                    | 3.10                                | 3.18  | 3.26  | 3.35            | 3.55            |       |       |       |       |
| HGLB 2015-040   |                       | 4                         |                      |                          |                           | 45               | 4                       | 4,440                    | 4.13                                | 4.24  | 4.36  | 4.49            | 4.77            |       |       |       |       |
| HGLB 2015-060   |                       | 6                         |                      |                          |                           | 45               | 4                       | 4,440                    | 6.19                                | 6.37  | 6.56  | 6.76            | 7.22            |       |       |       |       |
| HGLB 2015-060-6 |                       | 6                         |                      |                          |                           | 50               | 6                       | 7,200                    | 6.19                                | 6.37  | 6.56  | 6.76            | 7.22            |       |       |       |       |
| HGLB 2015-080   |                       | 8                         |                      |                          |                           | 45               | 4                       | 4,680                    | 8.25                                | 8.50  | 8.76  | 9.04            | 9.67            |       |       |       |       |
| HGLB 2015-080-6 |                       | 8                         |                      |                          |                           | 50               | 6                       | 7,200                    | 8.25                                | 8.50  | 8.76  | 9.04            | 9.67            |       |       |       |       |
| HGLB 2015-100   |                       | 10                        |                      |                          |                           | 45               | 4                       | 5,040                    | 10.32                               | 10.63 | 10.96 | 11.32           | 12.11           |       |       |       |       |
| HGLB 2015-100-6 |                       | 10                        |                      |                          |                           | 50               | 6                       | 7,200                    | 10.32                               | 10.63 | 10.96 | 11.32           | 12.11           |       |       |       |       |
| HGLB 2015-120   |                       | 12                        |                      |                          |                           | 45               | 4                       | 5,400                    | 12.38                               | 12.76 | 13.16 | 13.60           | 14.56           |       |       |       |       |
| HGLB 2015-120-6 |                       | 12                        |                      |                          |                           | 50               | 6                       | 8,130                    | 12.38                               | 12.76 | 13.16 | 13.60           | 14.56           |       |       |       |       |
| HGLB 2015-140   |                       | 14                        |                      |                          |                           | 45               | 4                       | 5,400                    | 14.44                               | 14.89 | 15.36 | 15.87           | 17.01           |       |       |       |       |
| HGLB 2015-160   |                       | 16                        |                      |                          |                           | 50               | 4                       | 5,400                    | 16.50                               | 17.02 | 17.57 | 18.15           | 19.46           |       |       |       |       |
| HGLB 2015-200   |                       | 20                        |                      |                          |                           | 60               | 4                       | 5,400                    | 20.63                               | 21.28 | 21.97 | 22.71           | 24.35           |       |       |       |       |
| HGLB 2020-030   | R1                    | 3                         | 1.6                  | 1.98                     | 16°                       | 45               | 4                       | 3,840                    | 3.07                                | 3.14  | 3.21  | 3.29            | 3.47            |       |       |       |       |
| HGLB 2020-030-6 |                       | 3                         |                      |                          |                           | 50               | 6                       | 6,120                    | 3.07                                | 3.14  | 3.21  | 3.29            | 3.47            |       |       |       |       |
| HGLB 2020-040   |                       | 4                         |                      |                          |                           | 45               | 4                       | 3,840                    | 4.10                                | 4.20  | 4.31  | 4.43            | 4.70            |       |       |       |       |
| HGLB 2020-040-6 |                       | 4                         |                      |                          |                           | 50               | 6                       | 6,120                    | 4.10                                | 4.20  | 4.31  | 4.43            | 4.70            |       |       |       |       |
| HGLB 2020-060   |                       | 6                         |                      |                          |                           | 45               | 4                       | 4,320                    | 6.16                                | 6.33  | 6.51  | 6.71            | 7.14            |       |       |       |       |
| HGLB 2020-060-6 |                       | 6                         |                      |                          |                           | 50               | 6                       | 6,600                    | 6.16                                | 6.33  | 6.51  | 6.71            | 7.14            |       |       |       |       |
| HGLB 2020-080   |                       | 8                         |                      |                          |                           | 45               | 4                       | 4,680                    | 8.23                                | 8.46  | 8.72  | 8.99            | 9.59            |       |       |       |       |
| HGLB 2020-080-6 |                       | 8                         |                      |                          |                           | 50               | 6                       | 7,080                    | 8.23                                | 8.46  | 8.72  | 8.99            | 9.59            |       |       |       |       |
| HGLB 2020-100   |                       | 10                        |                      |                          |                           | 45               | 4                       | 4,680                    | 10.29                               | 10.59 | 10.92 | 11.26           | 12.04           |       |       |       |       |
| HGLB 2020-100-6 |                       | 10                        |                      |                          |                           | 50               | 6                       | 7,080                    | 10.29                               | 10.59 | 10.92 | 11.26           | 12.04           |       |       |       |       |
| HGLB 2020-120   |                       | 12                        |                      |                          |                           | 45               | 4                       | 4,680                    | 12.35                               | 12.72 | 13.12 | 13.54           | 14.48           |       |       |       |       |
| HGLB 2020-120-6 |                       | 12                        |                      |                          |                           | 50               | 6                       | 7,080                    | 12.35                               | 12.72 | 13.12 | 13.54           | 14.48           |       |       |       |       |
| HGLB 2020-140   |                       | 14                        |                      |                          |                           | 45               | 4                       | 4,680                    | 14.41                               | 14.85 | 15.32 | 15.82           | 16.93           |       |       |       |       |
| HGLB 2020-160   |                       | 16                        |                      |                          |                           | 45               | 4                       | 4,680                    | 16.48                               | 16.98 | 17.52 | 18.10           | 19.38           |       |       |       |       |
| HGLB 2020-200   |                       | 20                        |                      |                          |                           | 60               | 4                       | 4,680                    | 20.60                               | 21.24 | 21.92 | 22.65           | No Interference |       |       |       |       |
| HGLB 2020-250   |                       | 25                        |                      |                          |                           | 60               | 4                       | 6,480                    | 25.76                               | 26.56 | 27.42 | 28.34           | No Interference |       |       |       |       |
| HGLB 2020-300   |                       | 30                        |                      |                          |                           | 70               | 4                       | 7,320                    | 30.92                               | 31.89 | 32.93 | No Interference | No Interference |       |       |       |       |
| HGLB 2030-060   |                       | R1.5                      |                      |                          |                           | 6                | 2.4                     | 2.95                     | 16°                                 | 60    | 6     | 4,680           | 6.20            | 6.35  | 6.52  | 6.69  | 7.09  |
| HGLB 2030-080   |                       |                           |                      |                          |                           | 8                |                         |                          |                                     | 60    | 6     | 4,680           | 8.26            | 8.48  | 8.72  | 8.97  | 9.54  |
| HGLB 2030-100   |                       |                           |                      |                          |                           | 10               |                         |                          |                                     | 60    | 6     | 5,400           | 10.32           | 10.61 | 10.92 | 11.25 | 11.99 |
| HGLB 2030-120   | 12                    |                           | 60                   | 6                        | 5,640                     | 12.38            |                         |                          |                                     | 12.74 | 13.12 | 13.53           | 14.43           |       |       |       |       |
| HGLB 2030-140   | 14                    |                           | 60                   | 6                        | 6,240                     | 14.45            |                         |                          |                                     | 14.87 | 15.32 | 15.80           | 16.88           |       |       |       |       |
| HGLB 2030-160   | 16                    |                           | 60                   | 6                        | 6,240                     | 16.51            |                         |                          |                                     | 17.00 | 17.52 | 18.08           | 19.33           |       |       |       |       |
| HGLB 2030-180   | 18                    |                           | 60                   | 6                        | 6,280                     | 18.57            |                         |                          |                                     | 19.13 | 19.72 | 20.36           | 21.78           |       |       |       |       |
| HGLB 2030-200   | 20                    |                           | 70                   | 6                        | 6,000                     | 20.64            |                         |                          |                                     | 21.26 | 21.92 | 22.64           | 24.22           |       |       |       |       |
| HGLB 2030-220   | 22                    |                           | 70                   | 6                        | 6,040                     | 22.70            |                         |                          |                                     | 23.39 | 24.12 | 24.91           | 26.67           |       |       |       |       |
| HGLB 2030-250   | 25                    |                           | 70                   | 6                        | 6,000                     | 25.79            |                         |                          |                                     | 26.58 | 27.43 | 28.33           | 30.34           |       |       |       |       |
| HGLB 2030-270   | 27                    |                           | 70                   | 6                        | 6,040                     | 27.86            |                         |                          |                                     | 28.71 | 29.63 | 30.61           | No Interference |       |       |       |       |
| HGLB 2030-300   | 30                    |                           | 70                   | 6                        | 6,840                     | 30.95            |                         |                          |                                     | 31.91 | 32.93 | 34.02           | No Interference |       |       |       |       |

Unit (mm)

| Model Number  | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bia | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|---------------|-----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|               |                       |                           |                      |                          |                       |                  |                         |                          | 30°                                 | 1°              | 1°30'           | 2°              | 3°              |
| HGLB 2040-080 | R2                    | 8                         | 3.2                  | 3.95                     | 16°                   | 70               | 6                       | 4,800                    | 8.24                                | 8.45            | 8.67            | 8.90            | 9.43            |
| HGLB 2040-100 |                       | 10                        |                      |                          |                       | 70               | 6                       | 4,800                    | 10.31                               | 10.58           | 10.87           | 11.18           | 11.88           |
| HGLB 2040-120 |                       | 12                        |                      |                          |                       | 70               | 6                       | 6,240                    | 12.37                               | 12.71           | 13.07           | 13.46           | 14.32           |
| HGLB 2040-140 |                       | 14                        |                      |                          |                       | 70               | 6                       | 6,240                    | 14.43                               | 14.84           | 15.27           | 15.74           | 16.77           |
| HGLB 2040-160 |                       | 16                        |                      |                          |                       | 70               | 6                       | 6,240                    | 16.49                               | 16.97           | 17.47           | 18.01           | 19.22           |
| HGLB 2040-180 |                       | 18                        |                      |                          |                       | 70               | 6                       | 6,380                    | 18.56                               | 19.10           | 19.67           | 20.29           | No Interference |
| HGLB 2040-200 |                       | 20                        |                      |                          |                       | 70               | 6                       | 6,240                    | 20.62                               | 21.23           | 21.87           | 22.57           | No Interference |
| HGLB 2040-220 |                       | 22                        |                      |                          |                       | 70               | 6                       | 6,380                    | 22.68                               | 23.36           | 24.08           | 24.85           | No Interference |
| HGLB 2040-250 |                       | 25                        |                      |                          |                       | 70               | 6                       | 6,240                    | 25.78                               | 26.55           | 27.38           | 28.26           | No Interference |
| HGLB 2040-270 |                       | 27                        |                      |                          |                       | 70               | 6                       | 6,380                    | 27.84                               | 28.68           | 29.58           | 30.54           | No Interference |
| HGLB 2040-300 |                       | 30                        |                      |                          |                       | 70               | 6                       | 6,240                    | 30.93                               | 31.87           | 32.88           | No Interference | No Interference |
| HGLB 2040-350 |                       | 35                        |                      |                          |                       | 80               | 6                       | 7,200                    | 36.09                               | 37.20           | 38.38           | No Interference | No Interference |
| HGLB 2040-400 |                       | 40                        |                      |                          |                       | 90               | 6                       | 8,040                    | 41.25                               | 42.52           | No Interference | No Interference | No Interference |
| HGLB 2060-100 |                       | R3                        |                      |                          |                       | 10               | 4.8                     | 5.95                     | —                                   | 80              | 6               | 7,800           | No Interference |
| HGLB 2060-150 | 15                    |                           | 80                   | 6                        | 7,800                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HGLB 2060-180 | 18                    |                           | 80                   | 6                        | 7,890                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HGLB 2060-200 | 20                    |                           | 80                   | 6                        | 7,800                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HGLB 2060-250 | 25                    |                           | 80                   | 6                        | 7,800                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HGLB 2060-300 | 30                    |                           | 80                   | 6                        | 8,040                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HGLB 2060-350 | 35                    |                           | 80                   | 6                        | 8,040                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HGLB 2060-400 | 40                    |                           | 90                   | 6                        | 8,760                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HGLB 2060-500 | 50                    |                           | 120                  | 6                        | 9,480                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |

∅3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral

Spiral  
V Cutter

Drill

Drill

Technical Data

Technical Data

Milling Conditions for HGLB

| WORK MATERIAL |                          |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX<br>(~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                                | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001-002      | R0.05                    | 0.2                   | 48,000  | 200                | 0.005                           | 0.01                             | 48,000                                 | 200                | 0.005                           | 0.01                             | 48,000                                 | 150                | 0.003                           | 0.006                            | 40,000                                 | 120                | 0.002                           | 0.004                            |
| 2001-003      |                          | 0.3                   | 48,000  | 200                | 0.005                           | 0.01                             | 48,000                                 | 200                | 0.005                           | 0.01                             | 48,000                                 | 150                | 0.003                           | 0.006                            | 40,000                                 | 120                | 0.002                           | 0.004                            |
| 2001-005      |                          | 0.5                   | 48,000  | 200                | 0.005                           | 0.01                             | 48,000                                 | 200                | 0.005                           | 0.01                             | 48,000                                 | 150                | 0.003                           | 0.006                            | 40,000                                 | 120                | 0.002                           | 0.004                            |
| 20015-003     | R0.075                   | 0.3                   | 48,000  | 230                | 0.007                           | 0.014                            | 48,000                                 | 230                | 0.007                           | 0.014                            | 48,000                                 | 170                | 0.005                           | 0.01                             | 40,000                                 | 135                | 0.003                           | 0.006                            |
| 20015-005     |                          | 0.5                   | 48,000  | 230                | 0.007                           | 0.014                            | 48,000                                 | 230                | 0.007                           | 0.014                            | 48,000                                 | 170                | 0.005                           | 0.01                             | 40,000                                 | 135                | 0.003                           | 0.006                            |
| 20015-0075    |                          | 0.75                  | 48,000  | 230                | 0.007                           | 0.014                            | 48,000                                 | 230                | 0.007                           | 0.014                            | 48,000                                 | 170                | 0.005                           | 0.01                             | 40,000                                 | 135                | 0.003                           | 0.006                            |
| 20015-010     | R0.1                     | 1                     | 38,400  | 160                | 0.005                           | 0.01                             | 38,400                                 | 160                | 0.005                           | 0.01                             | 38,400                                 | 120                | 0.003                           | 0.007                            | 32,000                                 | 90                 | 0.002                           | 0.004                            |
| 2002-003      |                          | 0.3                   | 44,000  | 250                | 0.01                            | 0.03                             | 42,000                                 | 250                | 0.01                            | 0.03                             | 40,000                                 | 200                | 0.008                           | 0.024                            | 36,000                                 | 150                | 0.006                           | 0.018                            |
| 2002-005      |                          | 0.5                   | 44,000  | 250                | 0.01                            | 0.03                             | 42,000                                 | 250                | 0.01                            | 0.03                             | 40,000                                 | 200                | 0.008                           | 0.024                            | 36,000                                 | 150                | 0.006                           | 0.018                            |
| 2002-0075     | R0.1                     | 0.75                  | 44,000  | 250                | 0.01                            | 0.03                             | 42,000                                 | 250                | 0.01                            | 0.03                             | 40,000                                 | 200                | 0.008                           | 0.024                            | 36,000                                 | 150                | 0.006                           | 0.018                            |
| 2002-010      |                          | 1                     | 44,000  | 250                | 0.01                            | 0.03                             | 42,000                                 | 250                | 0.01                            | 0.03                             | 40,000                                 | 200                | 0.008                           | 0.024                            | 36,000                                 | 150                | 0.006                           | 0.018                            |
| 2002-015      |                          | 1.5                   | 35,200  | 175                | 0.008                           | 0.023                            | 33,600                                 | 175                | 0.008                           | 0.023                            | 32,000                                 | 140                | 0.006                           | 0.018                            | 28,800                                 | 100                | 0.004                           | 0.012                            |
| 2002-020      | R0.15                    | 2                     | 35,200  | 120                | 0.003                           | 0.008                            | 33,600                                 | 100                | 0.003                           | 0.008                            | 32,000                                 | 90                 | 0.003                           | 0.008                            | 28,800                                 | 70                 | 0.002                           | 0.006                            |
| 2003-005      |                          | 0.5                   | 44,000  | 400                | 0.01                            | 0.03                             | 42,000                                 | 350                | 0.01                            | 0.03                             | 40,000                                 | 300                | 0.01                            | 0.03                             | 36,000                                 | 250                | 0.008                           | 0.024                            |
| 2003-0075     |                          | 0.75                  | 44,000  | 400                | 0.01                            | 0.03                             | 42,000                                 | 350                | 0.01                            | 0.03                             | 40,000                                 | 300                | 0.01                            | 0.03                             | 36,000                                 | 250                | 0.008                           | 0.024                            |
| 2003-010      | R0.15                    | 1                     | 44,000  | 400                | 0.01                            | 0.03                             | 42,000                                 | 350                | 0.01                            | 0.03                             | 40,000                                 | 300                | 0.01                            | 0.03                             | 36,000                                 | 250                | 0.008                           | 0.024                            |
| 2003-015      |                          | 1.5                   | 44,000  | 400                | 0.01                            | 0.03                             | 42,000                                 | 350                | 0.01                            | 0.03                             | 40,000                                 | 300                | 0.01                            | 0.03                             | 36,000                                 | 250                | 0.008                           | 0.024                            |
| 2003-020      |                          | 2                     | 35,200  | 280                | 0.008                           | 0.023                            | 33,600                                 | 245                | 0.008                           | 0.023                            | 32,000                                 | 210                | 0.008                           | 0.023                            | 28,800                                 | 175                | 0.006                           | 0.018                            |
| 2003-025      | R0.2                     | 2.5                   | 35,200  | 185                | 0.006                           | 0.017                            | 33,600                                 | 165                | 0.006                           | 0.017                            | 32,000                                 | 150                | 0.006                           | 0.017                            | 28,800                                 | 115                | 0.005                           | 0.014                            |
| 2003-030      |                          | 3                     | 35,200  | 140                | 0.004                           | 0.01                             | 33,600                                 | 125                | 0.004                           | 0.01                             | 32,000                                 | 110                | 0.004                           | 0.01                             | 28,800                                 | 85                 | 0.003                           | 0.009                            |
| 2004-005      |                          | 0.5                   | 44,000  | 600                | 0.015                           | 0.045                            | 42,000                                 | 550                | 0.015                           | 0.045                            | 40,000                                 | 500                | 0.013                           | 0.036                            | 36,000                                 | 350                | 0.01                            | 0.027                            |
| 2004-0075     | R0.2                     | 0.75                  | 44,000  | 600                | 0.015                           | 0.045                            | 42,000                                 | 550                | 0.015                           | 0.045                            | 40,000                                 | 500                | 0.013                           | 0.036                            | 36,000                                 | 350                | 0.01                            | 0.027                            |
| 2004-010      |                          | 1                     | 44,000  | 600                | 0.015                           | 0.045                            | 42,000                                 | 550                | 0.015                           | 0.045                            | 40,000                                 | 500                | 0.013                           | 0.036                            | 36,000                                 | 350                | 0.01                            | 0.027                            |
| 2004-0125     |                          | 1.25                  | 44,000  | 600                | 0.015                           | 0.045                            | 42,000                                 | 550                | 0.015                           | 0.045                            | 40,000                                 | 500                | 0.013                           | 0.036                            | 36,000                                 | 350                | 0.01                            | 0.027                            |
| 2004-015      | R0.2                     | 1.5                   | 44,000  | 600                | 0.015                           | 0.045                            | 42,000                                 | 550                | 0.015                           | 0.045                            | 40,000                                 | 500                | 0.013                           | 0.036                            | 36,000                                 | 350                | 0.01                            | 0.027                            |
| 2004-020      |                          | 2                     | 44,000  | 600                | 0.015                           | 0.045                            | 42,000                                 | 550                | 0.015                           | 0.045                            | 40,000                                 | 500                | 0.013                           | 0.036                            | 36,000                                 | 350                | 0.01                            | 0.027                            |
| 2004-025      |                          | 2.5                   | 35,200  | 420                | 0.011                           | 0.034                            | 33,600                                 | 385                | 0.011                           | 0.034                            | 32,000                                 | 350                | 0.01                            | 0.027                            | 28,800                                 | 250                | 0.008                           | 0.02                             |
| 2004-030      | R0.25                    | 3                     | 35,200  | 330                | 0.008                           | 0.024                            | 33,600                                 | 310                | 0.008                           | 0.024                            | 32,000                                 | 280                | 0.008                           | 0.022                            | 28,000                                 | 200                | 0.006                           | 0.016                            |
| 2004-035      |                          | 3.5                   | 35,200  | 300                | 0.007                           | 0.022                            | 31,900                                 | 280                | 0.007                           | 0.022                            | 30,400                                 | 250                | 0.007                           | 0.02                             | 26,600                                 | 175                | 0.005                           | 0.014                            |
| 2004-040      |                          | 4                     | 35,200  | 270                | 0.006                           | 0.019                            | 30,240                                 | 250                | 0.006                           | 0.019                            | 28,800                                 | 220                | 0.006                           | 0.018                            | 25,200                                 | 150                | 0.004                           | 0.012                            |
| 2005-010      | R0.25                    | 1                     | 44,000  | 900                | 0.02                            | 0.065                            | 40,000                                 | 800                | 0.015                           | 0.05                             | 36,000                                 | 600                | 0.015                           | 0.05                             | 30,000                                 | 400                | 0.015                           | 0.03                             |
| 2005-015      |                          | 1.5                   | 44,000  | 900                | 0.02                            | 0.065                            | 40,000                                 | 800                | 0.015                           | 0.05                             | 36,000                                 | 600                | 0.015                           | 0.05                             | 30,000                                 | 400                | 0.015                           | 0.03                             |
| 2005-020      |                          | 2                     | 44,000  | 900                | 0.02                            | 0.065                            | 40,000                                 | 800                | 0.015                           | 0.05                             | 36,000                                 | 600                | 0.015                           | 0.05                             | 30,000                                 | 400                | 0.015                           | 0.03                             |
| 2005-025      | R0.25                    | 2.5                   | 44,000  | 900                | 0.02                            | 0.065                            | 40,000                                 | 800                | 0.015                           | 0.05                             | 36,000                                 | 600                | 0.015                           | 0.05                             | 30,000                                 | 400                | 0.015                           | 0.03                             |
| 2005-030      |                          | 3                     | 32,700  | 450                | 0.01                            | 0.04                             | 31,500                                 | 400                | 0.01                            | 0.03                             | 30,000                                 | 300                | 0.008                           | 0.03                             | 24,000                                 | 200                | 0.007                           | 0.015                            |
| 2005-035      |                          | 3.5                   | 32,700  | 450                | 0.01                            | 0.04                             | 31,500                                 | 400                | 0.01                            | 0.03                             | 30,000                                 | 300                | 0.008                           | 0.03                             | 24,000                                 | 200                | 0.007                           | 0.015                            |
| 2005-040      | R0.25                    | 4                     | 32,700  | 450                | 0.01                            | 0.04                             | 31,500                                 | 400                | 0.01                            | 0.03                             | 30,000                                 | 300                | 0.008                           | 0.03                             | 24,000                                 | 200                | 0.007                           | 0.015                            |
| 2005-045      |                          | 4.5                   | 29,430  | 405                | 0.008                           | 0.03                             | 28,350                                 | 360                | 0.008                           | 0.025                            | 27,000                                 | 270                | 0.006                           | 0.025                            | 21,600                                 | 180                | 0.005                           | 0.013                            |
| 2005-050      |                          | 5                     | 26,160  | 360                | 0.005                           | 0.02                             | 25,200                                 | 320                | 0.005                           | 0.02                             | 24,000                                 | 240                | 0.004                           | 0.02                             | 19,200                                 | 160                | 0.003                           | 0.01                             |
| 2005-060      | R0.25                    | 6                     | 26,160  | 360                | 0.005                           | 0.02                             | 25,200                                 | 320                | 0.005                           | 0.02                             | 24,000                                 | 240                | 0.004                           | 0.02                             | 19,200                                 | 160                | 0.003                           | 0.01                             |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

## Milling Conditions for HGLB

| WORK MATERIAL |                          | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX<br>(~55HRC) |                                    |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                                 |                                  |      |
|---------------|--------------------------|---|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm)   | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |      |
| 2006-010      | R0.3                     | 1   | 40,000                             | 1,400              | 0.045                           | 0.15                             | 36,000                                 | 1,500              | 0.03                            | 0.13                             | 32,000                                 | 1,000              | 0.02                            | 0.1                              | 25,000                                 | 600                | 0.02                            | 0.1                              |      |
| 2006-015      |                          | 1.5   | 40,000                             | 1,400              | 0.03                            | 0.13                             | 36,000                                 | 1,300              | 0.03                            | 0.13                             | 32,000                                 | 1,000              | 0.02                            | 0.1                              | 25,000                                 | 600                | 0.02                            | 0.1                              |      |
| 2006-020      |                          | 2   | 40,000                             | 1,400              | 0.03                            | 0.13                             | 36,000                                 | 1,300              | 0.03                            | 0.13                             | 32,000                                 | 1,000              | 0.02                            | 0.1                              | 25,000                                 | 600                | 0.02                            | 0.1                              |      |
| 2006-025      |                          | 2.5   | 40,000                             | 1,200              | 0.025                           | 0.1                              | 36,000                                 | 1,100              | 0.025                           | 0.1                              | 32,000                                 | 900                | 0.02                            | 0.1                              | 25,000                                 | 500                | 0.02                            | 0.1                              |      |
| 2006-030      |                          | 3   | 40,000                             | 1,200              | 0.025                           | 0.1                              | 36,000                                 | 1,100              | 0.025                           | 0.1                              | 32,000                                 | 900                | 0.02                            | 0.1                              | 25,000                                 | 500                | 0.02                            | 0.1                              |      |
| 2006-035      |                          | 3.5   | 40,000                             | 1,100              | 0.023                           | 0.09                             | 34,000                                 | 950                | 0.023                           | 0.09                             | 32,000                                 | 800                | 0.018                           | 0.09                             | 25,000                                 | 450                | 0.015                           | 0.09                             |      |
| 2006-040      |                          | 4   | 40,000                             | 1,000              | 0.02                            | 0.08                             | 32,000                                 | 800                | 0.02                            | 0.08                             | 32,000                                 | 700                | 0.015                           | 0.07                             | 25,000                                 | 400                | 0.01                            | 0.075                            |      |
| 2006-045      |                          | 4.5   | 32,000                             | 600                | 0.01                            | 0.07                             | 28,000                                 | 600                | 0.01                            | 0.05                             | 25,600                                 | 500                | 0.01                            | 0.05                             | 20,000                                 | 300                | 0.005                           | 0.05                             |      |
| 2006-050      |                          | 5   | 32,000                             | 600                | 0.01                            | 0.07                             | 28,000                                 | 600                | 0.01                            | 0.05                             | 25,600                                 | 500                | 0.01                            | 0.05                             | 20,000                                 | 300                | 0.005                           | 0.05                             |      |
| 2006-055      |                          | 5.5   | 32,000                             | 600                | 0.01                            | 0.07                             | 28,000                                 | 600                | 0.01                            | 0.05                             | 25,600                                 | 500                | 0.01                            | 0.05                             | 20,000                                 | 300                | 0.005                           | 0.05                             |      |
| 2006-060      |                          | 6   | 32,000                             | 600                | 0.01                            | 0.07                             | 28,000                                 | 600                | 0.01                            | 0.05                             | 25,600                                 | 500                | 0.01                            | 0.05                             | 20,000                                 | 300                | 0.005                           | 0.05                             |      |
| 2006-080      |                          | 8   | 25,600                             | 480                | 0.008                           | 0.02                             | 22,400                                 | 480                | 0.008                           | 0.02                             | 20,480                                 | 350                | 0.007                           | 0.02                             | 16,000                                 | 210                | 0.004                           | 0.01                             |      |
| 2006-100      |                          | 10  | 20,480                             | 390                | 0.006                           | 0.02                             | 17,920                                 | 390                | 0.006                           | 0.02                             | 16,400                                 | 250                | 0.005                           | 0.02                             | 12,800                                 | 150                | 0.003                           | 0.01                             |      |
| 2008-020      |                          | R0.4  | 2                                  | 35,000             | 1,600                           | 0.06                             | 0.21                                   | 30,000             | 1,600                           | 0.04                             | 0.17                                   | 26,000             | 1,350                           | 0.04                             | 0.15                                   | 20,000             | 700                             | 0.02                             | 0.12 |
| 2008-025      |                          |   | 2.5                                | 35,000             | 1,600                           | 0.06                             | 0.21                                   | 30,000             | 1,600                           | 0.04                             | 0.17                                   | 26,000             | 1,350                           | 0.04                             | 0.15                                   | 20,000             | 700                             | 0.02                             | 0.12 |
| 2008-030      | 3                        |   | 35,000                             | 1,600              | 0.06                            | 0.21                             | 30,000                                 | 1,600              | 0.04                            | 0.17                             | 26,000                                 | 1,350              | 0.04                            | 0.15                             | 20,000                                 | 700                | 0.02                            | 0.12                             |      |
| 2008-040      | 4                        |   | 35,000                             | 1,600              | 0.06                            | 0.21                             | 30,000                                 | 1,600              | 0.04                            | 0.17                             | 26,000                                 | 1,350              | 0.04                            | 0.15                             | 20,000                                 | 700                | 0.02                            | 0.12                             |      |
| 2008-050      | 5                        |   | 31,500                             | 1,300              | 0.04                            | 0.17                             | 27,500                                 | 1,300              | 0.03                            | 0.15                             | 23,400                                 | 1,000              | 0.03                            | 0.11                             | 18,000                                 | 530                | 0.015                           | 0.09                             |      |
| 2008-060      | 6                        |   | 28,000                             | 1,000              | 0.02                            | 0.12                             | 25,000                                 | 1,000              | 0.02                            | 0.12                             | 20,800                                 | 675                | 0.02                            | 0.075                            | 16,000                                 | 350                | 0.01                            | 0.06                             |      |
| 2008-070      | 7                        |   | 25,200                             | 900                | 0.02                            | 0.11                             | 22,500                                 | 900                | 0.02                            | 0.11                             | 18,700                                 | 600                | 0.018                           | 0.068                            | 14,400                                 | 330                | 0.009                           | 0.05                             |      |
| 2008-080      | 8                        |   | 22,400                             | 800                | 0.02                            | 0.1                              | 20,000                                 | 800                | 0.02                            | 0.1                              | 16,640                                 | 540                | 0.016                           | 0.06                             | 12,800                                 | 300                | 0.008                           | 0.048                            |      |
| 2010-020      | R0.5                     |   | 2                                  | 30,000             | 1,750                           | 0.2                              | 0.4                                    | 24,000             | 2,000                           | 0.1                              | 0.3                                    | 21,000             | 1,750                           | 0.05                             | 0.2                                    | 16,000             | 875                             | 0.05                             | 0.2  |
| 2010-025      |                          |   | 2.5                                | 30,000             | 1,750                           | 0.2                              | 0.4                                    | 24,000             | 2,000                           | 0.1                              | 0.3                                    | 21,000             | 1,750                           | 0.05                             | 0.2                                    | 16,000             | 875                             | 0.05                             | 0.2  |
| 2010-030      |                          | 3   | 30,000                             | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.1                             | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             | 16,000                                 | 875                | 0.03                            | 0.17                             |      |
| 2010-040      |                          | 4   | 30,000                             | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.1                             | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             | 16,000                                 | 875                | 0.03                            | 0.17                             |      |
| 2010-050      |                          | 5   | 30,000                             | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.1                             | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             | 16,000                                 | 875                | 0.03                            | 0.17                             |      |
| 2010-060      |                          | 6   | 30,000                             | 1,150              | 0.06                            | 0.23                             | 21,500                                 | 1,250              | 0.03                            | 0.17                             | 19,700                                 | 1,050              | 0.025                           | 0.15                             | 14,500                                 | 525                | 0.025                           | 0.15                             |      |
| 2010-070      |                          | 7   | 27,000                             | 980                | 0.04                            | 0.19                             | 20,000                                 | 920                | 0.02                            | 0.15                             | 19,000                                 | 770                | 0.02                            | 0.14                             | 14,200                                 | 380                | 0.02                            | 0.14                             |      |
| 2010-080      |                          | 8   | 24,000                             | 800                | 0.025                           | 0.155                            | 18,500                                 | 580                | 0.015                           | 0.12                             | 18,400                                 | 480                | 0.015                           | 0.12                             | 13,800                                 | 240                | 0.015                           | 0.12                             |      |
| 2010-100      |                          | 10  | 22,000                             | 600                | 0.018                           | 0.13                             | 14,800                                 | 430                | 0.01                            | 0.09                             | 14,700                                 | 360                | 0.01                            | 0.09                             | 14,700                                 | 360                | 0.01                            | 0.09                             |      |
| 2010-120      |                          | 12  | 14,150                             | 320                | 0.015                           | 0.12                             | 13,400                                 | 380                | 0.008                           | 0.08                             | 13,300                                 | 290                | 0.008                           | 0.08                             | 13,300                                 | 290                | 0.008                           | 0.08                             |      |
| 2010-140      |                          | 14  | 13,500                             | 280                | 0.012                           | 0.1                              | 12,000                                 | 350                | 0.007                           | 0.08                             | 12,000                                 | 220                | 0.007                           | 0.08                             | 12,000                                 | 220                | 0.007                           | 0.08                             |      |
| 2010-160      |                          | 16  | 12,150                             | 250                | 0.011                           | 0.09                             | 10,800                                 | 320                | 0.006                           | 0.07                             | 10,800                                 | 200                | 0.006                           | 0.07                             | 10,800                                 | 200                | 0.006                           | 0.07                             |      |
| 2015-030      |                          | R0.75   | 3                                  | 30,000             | 2,450                           | 0.25                             | 0.55                                   | 17,000             | 2,000                           | 0.12                             | 0.4                                    | 15,000             | 1,750                           | 0.06                             | 0.29                                   | 11,250             | 875                             | 0.06                             | 0.29 |
| 2015-040      |                          |   | 4                                  | 30,000             | 2,450                           | 0.25                             | 0.55                                   | 17,000             | 2,000                           | 0.12                             | 0.4                                    | 15,000             | 1,750                           | 0.06                             | 0.29                                   | 11,250             | 875                             | 0.06                             | 0.29 |
| 2015-060      |                          |   | 6                                  | 30,000             | 2,450                           | 0.15                             | 0.45                                   | 17,000             | 2,000                           | 0.07                             | 0.31                                   | 15,000             | 1,750                           | 0.04                             | 0.24                                   | 11,250             | 875                             | 0.04                             | 0.24 |
| 2015-080      | 8                        |   | 23,500                             | 1,300              | 0.1                             | 0.37                             | 15,000                                 | 1,250              | 0.045                           | 0.25                             | 14,000                                 | 1,050              | 0.03                            | 0.21                             | 10,500                                 | 525                | 0.03                            | 0.21                             |      |
| 2015-100      | 10                       |   | 23,500                             | 1,300              | 0.1                             | 0.37                             | 15,000                                 | 1,250              | 0.045                           | 0.25                             | 14,000                                 | 1,050              | 0.03                            | 0.21                             | 10,500                                 | 525                | 0.03                            | 0.21                             |      |
| 2015-120      | 12                       |   | 13,100                             | 480                | 0.03                            | 0.21                             | 13,000                                 | 580                | 0.02                            | 0.17                             | 13,000                                 | 480                | 0.02                            | 0.17                             | 9,750                                  | 240                | 0.02                            | 0.17                             |      |
| 2015-140      | 14                       |   | 11,200                             | 400                | 0.025                           | 0.19                             | 10,900                                 | 490                | 0.015                           | 0.145                            | 10,900                                 | 390                | 0.015                           | 0.145                            | 8,200                                  | 190                | 0.015                           | 0.145                            |      |
| 2015-160      | 16                       |   | 10,000                             | 360                | 0.023                           | 0.17                             | 9,800                                  | 440                | 0.014                           | 0.13                             | 9,800                                  | 350                | 0.014                           | 0.13                             | 7,380                                  | 170                | 0.014                           | 0.13                             |      |
| 2015-200      | 20                       |   | 8,900                              | 320                | 0.02                            | 0.15                             | 8,700                                  | 390                | 0.012                           | 0.12                             | 8,700                                  | 310                | 0.012                           | 0.12                             | 6,560                                  | 150                | 0.012                           | 0.12                             |      |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

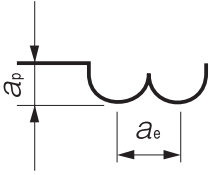


Milling Conditions for HGLB

| WORK MATERIAL |                          |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX<br>(~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                                | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2020-030      | R1                       | 3                     | 28,000  | 2,900              | 0.3                             | 0.7                              | 14,000                                 | 2,100              | 0.15                            | 0.5                              | 14,700                                 | 2,100              | 0.15                            | 0.35                             | 12,250                                 | 1,800              | 0.08                            | 0.35                             |
| 2020-040      |                          | 4                     | 28,000  | 2,900              | 0.3                             | 0.7                              | 14,000                                 | 2,100              | 0.15                            | 0.5                              | 14,700                                 | 2,100              | 0.15                            | 0.35                             | 12,250                                 | 1,800              | 0.08                            | 0.35                             |
| 2020-060      |                          | 6                     | 28,000  | 2,900              | 0.2                             | 0.6                              | 14,000                                 | 2,100              | 0.1                             | 0.4                              | 14,700                                 | 2,100              | 0.15                            | 0.3                              | 12,250                                 | 1,800              | 0.06                            | 0.3                              |
| 2020-080      |                          | 8                     | 28,000  | 2,900              | 0.2                             | 0.6                              | 14,000                                 | 2,100              | 0.1                             | 0.4                              | 14,700                                 | 2,100              | 0.15                            | 0.3                              | 12,250                                 | 1,800              | 0.06                            | 0.3                              |
| 2020-100      |                          | 10                    | 28,000  | 2,900              | 0.2                             | 0.6                              | 14,000                                 | 2,100              | 0.1                             | 0.4                              | 14,700                                 | 2,100              | 0.15                            | 0.3                              | 12,250                                 | 1,800              | 0.06                            | 0.3                              |
| 2020-120      |                          | 12                    | 19,500  | 1,350              | 0.12                            | 0.45                             | 12,400                                 | 1,350              | 0.06                            | 0.34                             | 13,800                                 | 1,320              | 0.09                            | 0.27                             | 11,500                                 | 1,100              | 0.045                           | 0.27                             |
| 2020-140      |                          | 14                    | 19,500  | 1,350              | 0.12                            | 0.45                             | 12,400                                 | 1,350              | 0.06                            | 0.34                             | 13,800                                 | 1,320              | 0.09                            | 0.27                             | 11,500                                 | 1,100              | 0.045                           | 0.27                             |
| 2020-160      |                          | 16                    | 10,800  | 500                | 0.05                            | 0.3                              | 10,800                                 | 600                | 0.03                            | 0.24                             | 12,840                                 | 588                | 0.06                            | 0.24                             | 10,700                                 | 490                | 0.03                            | 0.24                             |
| 2020-200      |                          | 20                    | 10,800  | 500                | 0.035                           | 0.25                             | 10,800                                 | 450                | 0.02                            | 0.19                             | 10,270                                 | 440                | 0.04                            | 0.19                             | 8,560                                  | 370                | 0.02                            | 0.19                             |
| 2020-250      |                          | 25                    | 9,720   | 450                | 0.032                           | 0.23                             | 9,720                                  | 410                | 0.018                           | 0.17                             | 9,250                                  | 400                | 0.036                           | 0.17                             | 7,700                                  | 330                | 0.018                           | 0.17                             |
| 2020-300      |                          | 30                    | 8,650   | 400                | 0.028                           | 0.2                              | 8,650                                  | 360                | 0.016                           | 0.15                             | 8,200                                  | 350                | 0.032                           | 0.15                             | 6,850                                  | 300                | 0.016                           | 0.15                             |
| 2030-060      |                          | 6                     | 21,000  | 3,000              | 0.4                             | 1                                | 13,250                                 | 2,500              | 0.24                            | 0.55                             | 11,040                                 | 2,280              | 0.24                            | 0.55                             | 9,200                                  | 1,900              | 0.12                            | 0.55                             |
| 2030-080      | 8                        | 21,000                | 3,000   | 0.4                | 1                               | 13,250                           | 2,500                                  | 0.24               | 0.55                            | 11,040                           | 2,280                                  | 0.24               | 0.55                            | 9,200                            | 1,900                                  | 0.12               | 0.55                            |                                  |
| 2030-100      | 10                       | 21,000                | 3,000   | 0.3                | 0.9                             | 12,200                           | 2,300                                  | 0.2                | 0.5                             | 11,040                           | 2,280                                  | 0.2                | 0.5                             | 9,200                            | 1,900                                  | 0.1                | 0.5                             |                                  |
| 2030-120      | 12                       | 21,000                | 3,000   | 0.3                | 0.9                             | 12,200                           | 2,300                                  | 0.2                | 0.5                             | 11,040                           | 2,280                                  | 0.2                | 0.5                             | 9,200                            | 1,900                                  | 0.1                | 0.5                             |                                  |
| 2030-140      | 14                       | 21,000                | 3,000   | 0.3                | 0.9                             | 12,200                           | 2,300                                  | 0.2                | 0.5                             | 11,040                           | 2,280                                  | 0.2                | 0.5                             | 9,200                            | 1,900                                  | 0.1                | 0.5                             |                                  |
| 2030-160      | 16                       | 21,000                | 3,000   | 0.3                | 0.9                             | 12,200                           | 2,300                                  | 0.2                | 0.5                             | 11,040                           | 2,280                                  | 0.2                | 0.5                             | 9,200                            | 1,900                                  | 0.1                | 0.5                             |                                  |
| 2030-180      | 18                       | 17,750                | 2,300   | 0.24               | 0.8                             | 11,750                           | 1,850                                  | 0.18               | 0.48                            | 10,680                           | 1,830                                  | 0.18               | 0.48                            | 8,900                            | 1,525                                  | 0.088              | 0.48                            |                                  |
| 2030-200      | 20                       | 14,500                | 1,600   | 0.18               | 0.7                             | 11,350                           | 1,400                                  | 0.15               | 0.45                            | 10,320                           | 1,380                                  | 0.15               | 0.45                            | 8,600                            | 1,150                                  | 0.075              | 0.45                            |                                  |
| 2030-220      | 22                       | 13,000                | 1,440   | 0.16               | 0.63                            | 11,000                           | 1,020                                  | 0.13               | 0.42                            | 9,960                            | 1,000                                  | 0.13               | 0.42                            | 8,300                            | 830                                    | 0.063              | 0.42                            |                                  |
| 2030-250      | 25                       | 11,600                | 1,280   | 0.14               | 0.56                            | 10,500                           | 620                                    | 0.1                | 0.38                            | 9,600                            | 610                                    | 0.1                | 0.38                            | 8,000                            | 510                                    | 0.05               | 0.38                            |                                  |
| 2030-270      | 27                       | 10,500                | 1,150   | 0.13               | 0.51                            | 9,000                            | 540                                    | 0.08               | 0.34                            | 8,200                            | 530                                    | 0.08               | 0.34                            | 6,850                            | 440                                    | 0.04               | 0.34                            |                                  |
| 2030-300      | 30                       | 9,280                 | 1,020   | 0.11               | 0.45                            | 7,500                            | 450                                    | 0.06               | 0.29                            | 6,840                            | 440                                    | 0.06               | 0.29                            | 5,700                            | 370                                    | 0.03               | 0.29                            |                                  |
| 2040-080      | 8                        | 18,000                | 3,200   | 0.5                | 1.3                             | 11,380                           | 2,880                                  | 0.36               | 0.95                            | 9,480                            | 2,400                                  | 0.3                | 0.75                            | 7,900                            | 2,000                                  | 0.15               | 0.75                            |                                  |
| 2040-100      | 10                       | 18,000                | 3,200   | 0.5                | 1.3                             | 11,380                           | 2,880                                  | 0.36               | 0.95                            | 9,480                            | 2,400                                  | 0.3                | 0.75                            | 7,900                            | 2,000                                  | 0.15               | 0.75                            |                                  |
| 2040-120      | 12                       | 18,000                | 3,200   | 0.4                | 1.2                             | 11,380                           | 2,880                                  | 0.31               | 0.85                            | 9,480                            | 2,400                                  | 0.26               | 0.7                             | 7,900                            | 2,000                                  | 0.13               | 0.7                             |                                  |
| 2040-140      | 14                       | 18,000                | 3,200   | 0.4                | 1.2                             | 11,380                           | 2,880                                  | 0.31               | 0.85                            | 9,480                            | 2,400                                  | 0.26               | 0.7                             | 7,900                            | 2,000                                  | 0.13               | 0.7                             |                                  |
| 2040-160      | 16                       | 18,000                | 3,200   | 0.4                | 1.2                             | 11,380                           | 2,880                                  | 0.31               | 0.85                            | 9,480                            | 2,400                                  | 0.26               | 0.7                             | 7,900                            | 2,000                                  | 0.13               | 0.7                             |                                  |
| 2040-180      | 18                       | 18,000                | 3,200   | 0.4                | 1.2                             | 11,380                           | 2,880                                  | 0.31               | 0.85                            | 9,480                            | 2,400                                  | 0.26               | 0.7                             | 7,900                            | 2,000                                  | 0.13               | 0.7                             |                                  |
| 2040-200      | 20                       | 18,000                | 3,200   | 0.4                | 1.2                             | 10,730                           | 1,800                                  | 0.21               | 0.7                             | 8,940                            | 1,500                                  | 0.18               | 0.55                            | 7,450                            | 1,250                                  | 0.09               | 0.55                            |                                  |
| 2040-220      | 22                       | 15,250                | 2,250   | 0.33               | 1.1                             | 10,730                           | 1,800                                  | 0.21               | 0.7                             | 8,940                            | 1,500                                  | 0.18               | 0.55                            | 7,450                            | 1,250                                  | 0.09               | 0.55                            |                                  |
| 2040-250      | 25                       | 12,500                | 1,250   | 0.25               | 0.95                            | 10,730                           | 1,800                                  | 0.21               | 0.7                             | 8,940                            | 1,500                                  | 0.18               | 0.55                            | 7,450                            | 1,250                                  | 0.09               | 0.55                            |                                  |
| 2040-270      | 27                       | 11,500                | 1,150   | 0.23               | 0.9                             | 10,400                           | 1,250                                  | 0.18               | 0.58                            | 8,670                            | 1,050                                  | 0.15               | 0.5                             | 7,250                            | 890                                    | 0.075              | 0.5                             |                                  |
| 2040-300      | 30                       | 10,630                | 1,000   | 0.2                | 0.76                            | 10,080                           | 780                                    | 0.15               | 0.45                            | 8,400                            | 650                                    | 0.12               | 0.45                            | 7,000                            | 540                                    | 0.06               | 0.45                            |                                  |
| 2040-350      | 35                       | 9,030                 | 800   | 0.16               | 0.61                            | 8,640                            | 730                                    | 0.13               | 0.43                            | 7,200                            | 610                                    | 0.11               | 0.43                            | 6,000                            | 510                                    | 0.055              | 0.43                            |                                  |
| 2040-400      | 40                       | 8,300                 | 700   | 0.14               | 0.54                            | 8,000                            | 700                                    | 0.12               | 0.42                            | 6,650                            | 590                                    | 0.11               | 0.42                            | 5,500                            | 500                                    | 0.05               | 0.42                            |                                  |
| 2060-100      | 10                       | 14,400                | 3,200   | 0.5                | 1.5                             | 9,140                            | 2,880                                  | 0.38               | 1.05                            | 7,620                            | 2,400                                  | 0.32               | 0.88                            | 6,350                            | 2,000                                  | 0.16               | 0.88                            |                                  |
| 2060-150      | 15                       | 14,400                | 3,200   | 0.5                | 1.5                             | 9,140                            | 2,880                                  | 0.38               | 1.05                            | 7,620                            | 2,400                                  | 0.32               | 0.88                            | 6,350                            | 2,000                                  | 0.16               | 0.88                            |                                  |
| 2060-180      | 18                       | 14,400                | 3,200   | 0.5                | 1.5                             | 9,140                            | 2,880                                  | 0.38               | 1.05                            | 7,620                            | 2,400                                  | 0.32               | 0.88                            | 6,350                            | 2,000                                  | 0.16               | 0.88                            |                                  |
| 2060-200      | 20                       | 14,400                | 3,200   | 0.5                | 1.5                             | 9,000                            | 2,300                                  | 0.32               | 0.95                            | 7,620                            | 2,400                                  | 0.32               | 0.88                            | 6,350                            | 2,000                                  | 0.16               | 0.88                            |                                  |
| 2060-250      | 25                       | 14,400                | 3,200   | 0.5                | 1.5                             | 8,100                            | 2,000                                  | 0.3                | 0.95                            | 7,500                            | 1,920                                  | 0.27               | 0.805                           | 6,250                            | 1,600                                  | 0.135              | 0.805                           |                                  |
| 2060-300      | 30                       | 14,400                | 3,200   | 0.5                | 1.5                             | 7,700                            | 1,800                                  | 0.26               | 0.88                            | 7,440                            | 1,500                                  | 0.22               | 0.73                            | 6,200                            | 1,250                                  | 0.11               | 0.73                            |                                  |
| 2060-350      | 35                       | 9,200                 | 2,050   | 0.32               | 1                               | 6,200                            | 1,450                                  | 0.21               | 0.71                            | 6,000                            | 1,200                                  | 0.18               | 0.59                            | 5,000                            | 1,000                                  | 0.09               | 0.59                            |                                  |
| 2060-400      | 40                       | 7,000                 | 1,050   | 0.2                | 0.8                             | 5,600                            | 1,000                                  | 0.19               | 0.64                            | 4,800                            | 950                                    | 0.14               | 0.47                            | 4,000                            | 810                                    | 0.07               | 0.47                            |                                  |
| 2060-500      | 50                       | 5,600                 | 850   | 0.16               | 0.6                             | 4,500                            | 810                                    | 0.15               | 0.52                            | 3,900                            | 780                                    | 0.12               | 0.38                            | 3,200                            | 650                                    | 0.06               | 0.38                            |                                  |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



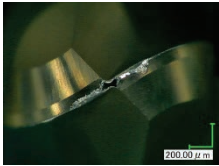


- Note:
- Decrease the feed rate more than 50% from the milling parameters when slot milling.
  - Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machines maximum speed, or when the tool is chattering and heats up to a red color.
  - Every coolant offers stable milling.

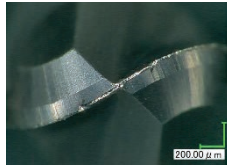
## Wear Comparison HGLB R1 × EL6

## HAP72 (69HRC)

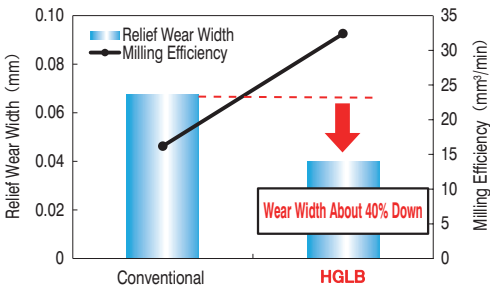
Tools after milling



Conventional



HGLB



### HGLB mills twice as efficiently as the conventional tool.

| Tool          | Conventional   | HGLB 2020-060            |
|---------------|--|--------------------------|
| Spindle Speed | 9,200 min <sup>-1</sup>                                | 12,250 min <sup>-1</sup> |
| Feed Rate     | 900 mm/min   | 1,800 mm/min             |
| $a_p$         | 0.06 mm  |                          |
| $a_e$         | 0.3 mm   |                          |
| Coolant       | Air Blow (Through Spindle)                             |                          |
| Milling Shape | Square Pocket<br>(20 x 15 x Depth 2 mm)<br>× 2 Pockets |                          |
| Cycle Time    | 76 min   | 50 min                   |

$$\text{Milling Efficiency (mm}^3/\text{min)} = \text{Feed Rate} \times a_p \times a_e$$

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.25~R1

# HWLB

Super  
MG

HMW  
COAT

30°

R  
±0.003

Shank Dia  
0/-0.004

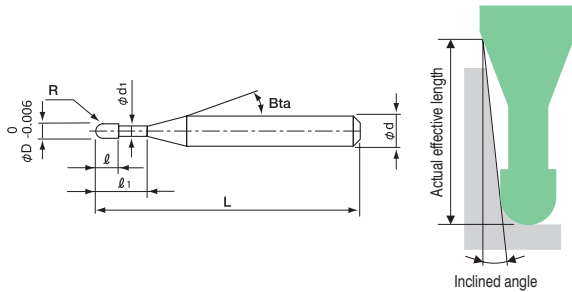
Back Taper  
Geometry

**NEW**

Back taper geometry does not apply to R0.45 or below, and  $\ell_1 / D \leq 10$ .

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ★               | ★      | ★      | ●      | ●      | ○         |                 |          | ○      |          |                       | ○               | ○                     |                  |                                       |



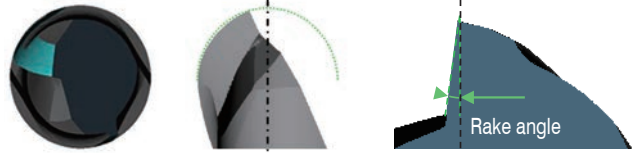
The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

## ◆ Variable rake angle design

Optimized rake angles are designed from the ball tip to the peripheral cutting edge.

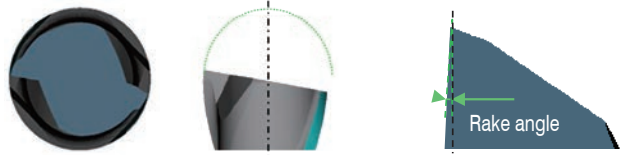
### Tip point

Negative rake angle design prevents fracture and chipping.



### Peripheral cutting edge

Slightly negative rake angle design reduces cutting resistance and prevents chattering.



## ◆ High Accuracy

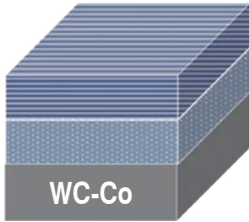
Even higher accuracy than our conventional tools!

Unit (mm)

| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy | Shank Diameter Tolerance |
|---------------------|--------------------|----------------------|--------------------------|
| R0.25 ~ R1          | 0/-0.006           | ± 0.003              | 0/-0.004 (h4)            |

# New coating HMWCOAT

New coating that is best suited for around 60HRC.

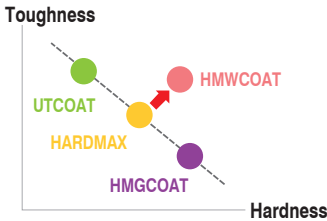


## Ultra-high hardness layer

Nano-laminated structure prevents peeling and cracking on high hardness layer.

## Shock absorption layer

Nanocomposite structure offers both hardness and toughness.



## Higher hardness and toughness than conventional coating

Improved wear resistance compared to HARDMAX coating for milling around 60HRC.

### How to find the best coating for your steel applications

| Coating series  | COPPER | CARBON STEELS | PREHARDENED STEELS | HARDENED STEELS |          |          |          |          |
|---|--------|---------------|--------------------|-----------------|----------|----------|----------|----------|
|   |        |               |                    | ~ 50 HRC        | ~ 55 HRC | ~ 60 HRC | ~ 65 HRC | ~ 70 HRC |
| <b>HMG COAT</b> <b>HMGCOAT</b><br>Best suited for milling high speed steel materials of 65HRC or above.                             |        |               | ○                  | ○               | ○        | ●        | ★        | ★        |
| <b>HMW COAT</b> <b>HMWCOAT</b><br>Improved wear resistance compared to HARDMAX coating for around 60HRC.                            | ○      | ○             | ●                  | ●               | ●        | ★        | ●        | ●        |
| <b>HARD MAX</b> <b>HARDMAX</b><br>Best suited for Prehardened Steels to Hardened Steels of 60HRC. Popular multi-purpose coating.    | ○      | ○             | ●                  | ●               | ●        | ●        | ○        |          |
| <b>UT COAT</b> <b>UTCOAT</b><br>High lubricity and toughness. Suited for a wide range of materials including raw materials and SUS. | ●      | ●             | ●                  | ●               | ○        |          |          |          |

### How to find the best long neck ball series for your steel applications

| Series                       | Features                                   | Ball tip design | COPPER | CARBON STEELS | PREHARDENED STEELS | HARDENED STEELS |          |          |          |          |
|------------------------------|--|-----------------|--------|---------------|--------------------|-----------------|----------|----------|----------|----------|
|                              |  |                 |        |               |                    | ~ 50 HRC        | ~ 55 HRC | ~ 60 HRC | ~ 65 HRC | ~ 70 HRC |
| <b>HGLB</b>                  | Best suited for Hard Materials             | Super Negative  |        |               | ○                  | ●               | ●        | ●        | ★        | ★        |
| <b>HWLB</b>                  | For Hard Materials                         | Negative        | ○      | ○             | ●                  | ★               | ★        | ★        | ●        | ●        |
| <b>HSLB</b><br><b>HSLB-S</b> | For Hard Materials<br>Multi-purpose        | Negative        | ○      | ○             | ●                  | ●               | ●        | ●        | ○        |          |
| <b>HLB</b>                   | Multi-purpose                              | Positive        | ●      | ○             | ●                  | ●               | ●        | ○        |          |          |
| <b>CSELB</b>                 | Multi-purpose<br>Excellent surface quality | Standard        | ●      | ●             | ●                  | ●               | ●        |          |          |          |

Total 43 models

Unit (mm)

| Model Number  | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |       |                 |
|---------------|-----------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|-------|-----------------|
|               |                       |                           |                      |                          |                           |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°    | 3°              |
| HWLB 2005-010 | RO.25                 | 1                         | 0.4                  | 0.49                     | 16°                       | 45               | 4                       | 4,380                    | 1.15                                | 1.19  | 1.22  | 1.26  | 1.34            |
| HWLB 2005-015 |                       | 1.5                       |                      |                          |                           |                  |                         |                          | 1.65                                | 1.71  | 1.76  | 1.82  | 1.94            |
| HWLB 2005-020 |                       | 2                         |                      |                          |                           |                  |                         |                          | 2.18                                | 2.24  | 2.31  | 2.39  | 2.55            |
| HWLB 2005-030 |                       | 3                         |                      |                          |                           |                  |                         |                          | 3.21                                | 3.31  | 3.41  | 3.53  | 3.77            |
| HWLB 2005-040 |                       | 4                         |                      |                          |                           |                  |                         |                          | 4.24                                | 4.37  | 4.51  | 4.66  | 5.00            |
| HWLB 2006-010 | RO.3                  | 1                         | 0.48                 | 0.59                     | 16°                       | 45               | 4                       | 3,740                    | 1.14                                | 1.18  | 1.22  | 1.25  | 1.33            |
| HWLB 2006-015 |                       | 1.5                       |                      |                          |                           |                  |                         |                          | 1.65                                | 1.71  | 1.76  | 1.81  | 1.93            |
| HWLB 2006-020 |                       | 2                         |                      |                          |                           |                  |                         |                          | 2.17                                | 2.24  | 2.31  | 2.38  | 2.54            |
| HWLB 2006-025 |                       | 2.5                       |                      |                          |                           |                  |                         |                          | 2.69                                | 2.77  | 2.86  | 2.95  | 3.15            |
| HWLB 2006-030 |                       | 3                         |                      |                          |                           |                  |                         |                          | 3.21                                | 3.31  | 3.41  | 3.52  | 3.76            |
| HWLB 2006-040 |                       | 4                         |                      |                          |                           |                  |                         |                          | 4.24                                | 4.37  | 4.51  | 4.66  | 4.99            |
| HWLB 2006-050 |                       | 5                         |                      |                          |                           |                  |                         |                          | 5.27                                | 5.44  | 5.61  | 5.80  | 6.21            |
| HWLB 2006-060 |                       | 6                         |                      |                          |                           |                  |                         |                          | 6.30                                | 6.50  | 6.71  | 6.93  | 7.43            |
| HWLB 2006-080 |                       | 8                         |                      |                          |                           |                  |                         |                          | 8.37                                | 8.63  | 8.91  | 9.21  | 9.88            |
| HWLB 2006-100 |                       | 10                        |                      |                          |                           |                  |                         |                          | 10.43                               | 10.76 | 11.11 | 11.49 | 12.33           |
| HWLB 2008-020 | RO.4                  | 2                         | 0.64                 | 0.79                     | 16°                       | 45               | 4                       | 3,380                    | 2.17                                | 2.23  | 2.30  | 2.37  | 2.52            |
| HWLB 2008-030 |                       | 3                         |                      |                          |                           |                  |                         |                          | 3.21                                | 3.30  | 3.40  | 3.50  | 3.74            |
| HWLB 2008-040 |                       | 4                         |                      |                          |                           |                  |                         |                          | 4.24                                | 4.36  | 4.50  | 4.64  | 4.97            |
| HWLB 2008-060 |                       | 6                         |                      |                          |                           |                  |                         |                          | 6.30                                | 6.49  | 6.70  | 6.92  | 7.41            |
| HWLB 2008-080 |                       | 8                         |                      |                          |                           |                  |                         |                          | 8.36                                | 8.62  | 8.90  | 9.20  | 9.86            |
| HWLB 2010-020 | RO.5                  | 2                         | 0.8                  | 0.98                     | 16°                       | 45               | 4                       | 2,820                    | 2.18                                | 2.24  | 2.30  | 2.36  | 2.51            |
| HWLB 2010-025 |                       | 2.5                       |                      |                          |                           |                  |                         |                          | 2.70                                | 2.77  | 2.85  | 2.93  | 3.12            |
| HWLB 2010-030 |                       | 3                         |                      |                          |                           |                  |                         |                          | 3.21                                | 3.30  | 3.40  | 3.50  | 3.73            |
| HWLB 2010-040 |                       | 4                         |                      |                          |                           |                  |                         |                          | 4.24                                | 4.37  | 4.50  | 4.64  | 4.96            |
| HWLB 2010-050 |                       | 5                         |                      |                          |                           |                  |                         |                          | 5.28                                | 5.43  | 5.60  | 5.78  | 6.18            |
| HWLB 2010-060 |                       | 6                         |                      |                          |                           |                  |                         |                          | 6.31                                | 6.50  | 6.70  | 6.92  | 7.40            |
| HWLB 2010-080 |                       | 8                         |                      |                          |                           |                  |                         |                          | 8.37                                | 8.63  | 8.90  | 9.20  | 9.85            |
| HWLB 2010-100 |                       | 10                        |                      |                          |                           |                  |                         |                          | 10.43                               | 10.76 | 11.10 | 11.47 | 12.30           |
| HWLB 2010-120 |                       | 12                        |                      |                          |                           |                  |                         |                          | 12.50                               | 12.89 | 13.30 | 13.75 | 14.75           |
| HWLB 2015-030 |                       | RO.75                     |                      |                          |                           |                  |                         |                          | 3                                   | 1.2   | 1.47  | 16°   | 45              |
| HWLB 2015-040 | 4                     |                           | 4.13                 | 4.24                     | 4.36                      | 4.49             | 4.77                    |                          |                                     |       |       |       |                 |
| HWLB 2015-060 | 6                     |                           | 6.19                 | 6.37                     | 6.56                      | 6.76             | 7.22                    |                          |                                     |       |       |       |                 |
| HWLB 2015-080 | 8                     |                           | 8.25                 | 8.50                     | 8.76                      | 9.04             | 9.67                    |                          |                                     |       |       |       |                 |
| HWLB 2015-100 | 10                    |                           | 10.32                | 10.63                    | 10.96                     | 11.32            | 12.11                   |                          |                                     |       |       |       |                 |
| HWLB 2020-030 | R1                    | 3                         | 1.6                  | 1.98                     | 16°                       | 45               | 4                       | 2,820                    | 3.07                                | 3.14  | 3.21  | 3.29  | 3.47            |
| HWLB 2020-040 |                       | 4                         |                      |                          |                           |                  |                         |                          | 4.10                                | 4.21  | 4.32  | 4.43  | 4.70            |
| HWLB 2020-060 |                       | 6                         |                      |                          |                           |                  |                         |                          | 6.17                                | 6.33  | 6.52  | 6.71  | 7.14            |
| HWLB 2020-080 |                       | 8                         |                      |                          |                           |                  |                         |                          | 8.23                                | 8.46  | 8.72  | 8.99  | 9.59            |
| HWLB 2020-100 |                       | 10                        |                      |                          |                           |                  |                         |                          | 10.29                               | 10.59 | 10.92 | 11.27 | 12.04           |
| HWLB 2020-120 |                       | 12                        |                      |                          |                           |                  |                         |                          | 12.35                               | 12.72 | 13.12 | 13.54 | 14.49           |
| HWLB 2020-140 |                       | 14                        |                      |                          |                           |                  |                         |                          | 14.42                               | 14.85 | 15.32 | 15.82 | 16.93           |
| HWLB 2020-160 |                       | 16                        |                      |                          |                           |                  |                         |                          | 16.48                               | 16.98 | 17.52 | 18.10 | 19.38           |
| HWLB 2020-200 |                       | 20                        |                      |                          |                           |                  |                         |                          | 20.60                               | 21.24 | 21.92 | 22.65 | No Interference |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling example R0.5 × EL2

SKD11 (60HRC)

### HWLB

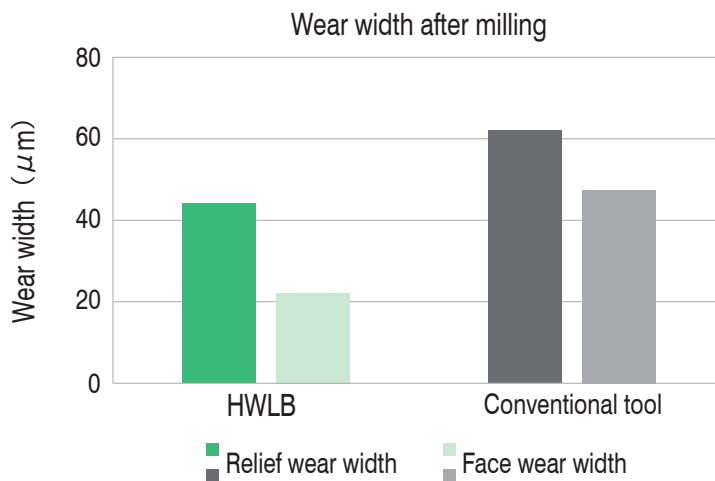


### Conventional tool



|               |                                    |
|---------------|------------------------------------|
| Spindle Speed | 24,000 min <sup>-1</sup>           |
| Feed Rate     | 2,000 mm/min                       |
| $a_p$         | 0.1 mm                             |
| $a_e$         | 0.3 mm                             |
| Coolant       | Air Blow                           |
| Milling Shape | Square Pocket<br>118 × 16 × 0.9 mm |
| Cycle Time    | 32 min                             |

HWLB shows little wear on the relief and face.



Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for HWLB

| WORK MATERIAL |                          |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX (~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                             | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2005          | R0.25                    | 1                     | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             | 22,500                                 | 150                | 0.007                           | 0.01                             |
|               |                          | 1.5                   | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             | 22,500                                 | 150                | 0.007                           | 0.01                             |
|               |                          | 2                     | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             | 22,500                                 | 150                | 0.007                           | 0.01                             |
|               |                          | 3                     | 40,000   | 500                | 0.01                            | 0.02                             | 31,000                                 | 400                | 0.007                           | 0.01                             | 28,550                                 | 230                | 0.005                           | 0.008                            | 21,400                                 | 115                | 0.005                           | 0.008                            |
|               |                          | 4                     | 32,700   | 180                | 0.005                           | 0.015                            | 27,150                                 | 150                | 0.003                           | 0.008                            | 25,650                                 | 100                | 0.002                           | 0.005                            | 19,900                                 | 50                 | 0.002                           | 0.005                            |
| 2006          | R0.3                     | 1                     | 40,000   | 1,400              | 0.045                           | 0.15                             | 30,000                                 | 1,500              | 0.03                            | 0.13                             | 26,500                                 | 1,000              | 0.015                           | 0.09                             | 20,000                                 | 500                | 0.015                           | 0.09                             |
|               |                          | 1.5                   | 40,000   | 1,100              | 0.03                            | 0.13                             | 30,000                                 | 1,200              | 0.02                            | 0.1                              | 26,500                                 | 800                | 0.01                            | 0.075                            | 20,000                                 | 400                | 0.01                            | 0.075                            |
|               |                          | 2                     | 40,000   | 1,100              | 0.03                            | 0.13                             | 30,000                                 | 1,200              | 0.02                            | 0.1                              | 26,500                                 | 800                | 0.01                            | 0.075                            | 20,000                                 | 400                | 0.01                            | 0.075                            |
|               |                          | 2.5                   | 40,000   | 800                | 0.02                            | 0.1                              | 30,000                                 | 800                | 0.015                           | 0.09                             | 26,500                                 | 520                | 0.008                           | 0.065                            | 20,000                                 | 260                | 0.008                           | 0.065                            |
|               |                          | 3                     | 40,000   | 800                | 0.02                            | 0.1                              | 30,000                                 | 800                | 0.015                           | 0.09                             | 26,500                                 | 520                | 0.008                           | 0.065                            | 20,000                                 | 260                | 0.008                           | 0.065                            |
|               |                          | 4                     | 40,000   | 500                | 0.015                           | 0.09                             | 30,000                                 | 500                | 0.01                            | 0.075                            | 26,500                                 | 340                | 0.006                           | 0.05                             | 20,000                                 | 170                | 0.006                           | 0.05                             |
|               |                          | 5                     | 32,000   | 400                | 0.01                            | 0.075                            | 25,000                                 | 390                | 0.007                           | 0.05                             | 23,000                                 | 260                | 0.005                           | 0.04                             | 18,000                                 | 130                | 0.005                           | 0.04                             |
|               |                          | 6                     | 24,000   | 300                | 0.007                           | 0.06                             | 21,000                                 | 320                | 0.005                           | 0.04                             | 19,500                                 | 210                | 0.004                           | 0.03                             | 15,000                                 | 105                | 0.004                           | 0.03                             |
|               |                          | 8                     | 16,000   | 200                | 0.005                           | 0.05                             | 16,000                                 | 240                | 0.003                           | 0.02                             | 16,000                                 | 160                | 0.003                           | 0.02                             | 12,000                                 | 80                 | 0.003                           | 0.02                             |
|               |                          | 10                    | 14,900   | 175                | 0.003                           | 0.02                             | 14,900                                 | 175                | 0.002                           | 0.015                            | 14,900                                 | 115                | 0.002                           | 0.015                            | 11,100                                 | 55                 | 0.002                           | 0.015                            |
| 2008          | R0.4                     | 2                     | 35,000   | 1,600              | 0.06                            | 0.21                             | 27,000                                 | 1,600              | 0.04                            | 0.17                             | 23,500                                 | 1,000              | 0.02                            | 0.12                             | 17,500                                 | 500                | 0.02                            | 0.12                             |
|               |                          | 3                     | 35,000   | 1,400              | 0.05                            | 0.19                             | 27,000                                 | 1,400              | 0.03                            | 0.15                             | 23,500                                 | 900                | 0.015                           | 0.1                              | 17,500                                 | 450                | 0.015                           | 0.1                              |
|               |                          | 4                     | 35,000   | 1,200              | 0.04                            | 0.17                             | 27,000                                 | 1,200              | 0.025                           | 0.135                            | 23,500                                 | 600                | 0.012                           | 0.095                            | 17,500                                 | 300                | 0.012                           | 0.095                            |
|               |                          | 6                     | 28,000   | 600                | 0.02                            | 0.12                             | 23,000                                 | 600                | 0.012                           | 0.095                            | 20,500                                 | 400                | 0.006                           | 0.065                            | 15,500                                 | 200                | 0.006                           | 0.065                            |
|               |                          | 8                     | 19,500   | 330                | 0.012                           | 0.095                            | 18,000                                 | 375                | 0.007                           | 0.07                             | 17,000                                 | 285                | 0.005                           | 0.06                             | 12,750                                 | 140                | 0.005                           | 0.06                             |
| 2010          | R0.5                     | 2                     | 30,000   | 1,750              | 0.2                             | 0.4                              | 24,000                                 | 2,000              | 0.1                             | 0.3                              | 21,000                                 | 1,750              | 0.05                            | 0.2                              | 16,000                                 | 875                | 0.05                            | 0.2                              |
|               |                          | 2.5                   | 30,000   | 1,750              | 0.2                             | 0.4                              | 24,000                                 | 2,000              | 0.1                             | 0.3                              | 21,000                                 | 1,750              | 0.05                            | 0.2                              | 16,000                                 | 875                | 0.05                            | 0.2                              |
|               |                          | 3                     | 30,000   | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.05                            | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             | 16,000                                 | 875                | 0.03                            | 0.17                             |
|               |                          | 4                     | 30,000   | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.05                            | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             | 16,000                                 | 875                | 0.03                            | 0.17                             |
|               |                          | 5                     | 30,000   | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.05                            | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             | 16,000                                 | 875                | 0.03                            | 0.17                             |
|               |                          | 6                     | 30,000   | 1,150              | 0.06                            | 0.23                             | 21,500                                 | 1,250              | 0.03                            | 0.17                             | 19,700                                 | 1,050              | 0.025                           | 0.15                             | 14,500                                 | 525                | 0.025                           | 0.15                             |
|               |                          | 8                     | 24,000   | 800                | 0.025                           | 0.155                            | 18,500                                 | 580                | 0.015                           | 0.12                             | 18,400                                 | 480                | 0.015                           | 0.12                             | 13,800                                 | 240                | 0.015                           | 0.12                             |
|               |                          | 10                    | 22,000   | 600                | 0.018                           | 0.13                             | 14,800                                 | 430                | 0.01                            | 0.09                             | 14,700                                 | 360                | 0.01                            | 0.09                             | 11,100                                 | 180                | 0.01                            | 0.09                             |
|               |                          | 12                    | 14,150   | 320                | 0.015                           | 0.12                             | 13,400                                 | 380                | 0.008                           | 0.08                             | 13,300                                 | 290                | 0.008                           | 0.08                             | 9,950                                  | 145                | 0.008                           | 0.08                             |
|               |                          | 2015                  | R0.75  | 3                  | 30,000                          | 2,450                            | 0.25                                   | 0.55               | 17,000                          | 2,000                            | 0.12                                   | 0.4                | 15,000                          | 1,750                            | 0.06                                   | 0.29               | 11,250                          | 875                              |
| 4             | 30,000                   |                       |  | 2,450              | 0.25                            | 0.55                             | 17,000                                 | 2,000              | 0.12                            | 0.4                              | 15,000                                 | 1,750              | 0.06                            | 0.29                             | 11,250                                 | 875                | 0.06                            | 0.29                             |
| 6             | 30,000                   |                       |  | 2,450              | 0.15                            | 0.45                             | 17,000                                 | 2,000              | 0.07                            | 0.31                             | 15,000                                 | 1,750              | 0.04                            | 0.24                             | 11,250                                 | 875                | 0.04                            | 0.24                             |
| 8             | 23,500                   |                       |  | 1,300              | 0.1                             | 0.37                             | 15,000                                 | 1,250              | 0.045                           | 0.25                             | 14,000                                 | 1,050              | 0.03                            | 0.21                             | 10,500                                 | 525                | 0.03                            | 0.21                             |
| 10            | 23,500                   | 1,300                 | 0.1  | 0.37               | 15,000                          | 1,250                            | 0.045                                  | 0.25               | 14,000                          | 1,050                            | 0.03                                   | 0.21               | 10,500                          | 525                              | 0.03                                   | 0.21               |                                 |                                  |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball

Taper Neck Ball

Taper

Barrel

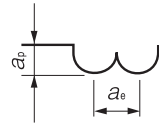
Spiral V Cutter

Drill

Technical Data

# Milling Conditions for HWLB

| WORK MATERIAL |                          |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX (~55HRC) |                    |                           |                            | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                           |                            | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                           |                            | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                           |                            |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------|----------------------------|--|--------------------|---------------------------|----------------------------|--|--------------------|---------------------------|----------------------------|--|--------------------|---------------------------|----------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                             | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth (mm) |
| 2020          | R1                       | 3                     | 28,000   | 2,900              | 0.3                       | 0.7                        | 14,000                                 | 2,100              | 0.15                      | 0.5                        | 12,250                                 | 1,800              | 0.08                      | 0.35                       | 9,200                                  | 900                | 0.08                      | 0.35                       |
|               |                          | 4                     | 28,000   | 2,900              | 0.3                       | 0.7                        | 14,000                                 | 2,100              | 0.15                      | 0.5                        | 12,250                                 | 1,800              | 0.08                      | 0.35                       | 9,200                                  | 900                | 0.08                      | 0.35                       |
|               |                          | 6                     | 28,000   | 2,900              | 0.2                       | 0.6                        | 14,000                                 | 2,100              | 0.1                       | 0.4                        | 12,250                                 | 1,800              | 0.06                      | 0.3                        | 9,200                                  | 900                | 0.06                      | 0.3                        |
|               |                          | 8                     | 28,000   | 2,900              | 0.2                       | 0.6                        | 14,000                                 | 2,100              | 0.1                       | 0.4                        | 12,250                                 | 1,800              | 0.06                      | 0.3                        | 9,200                                  | 900                | 0.06                      | 0.3                        |
|               |                          | 10                    | 28,000   | 2,900              | 0.2                       | 0.6                        | 14,000                                 | 2,100              | 0.1                       | 0.4                        | 12,250                                 | 1,800              | 0.06                      | 0.3                        | 9,200                                  | 900                | 0.06                      | 0.3                        |
|               |                          | 12                    | 19,500   | 1,350              | 0.12                      | 0.45                       | 12,400                                 | 1,350              | 0.06                      | 0.34                       | 11,500                                 | 1,100              | 0.045                     | 0.27                       | 8,650                                  | 550                | 0.045                     | 0.27                       |
|               |                          | 14                    | 19,500   | 1,350              | 0.12                      | 0.45                       | 12,400                                 | 1,350              | 0.06                      | 0.34                       | 11,500                                 | 1,100              | 0.045                     | 0.27                       | 8,650                                  | 550                | 0.045                     | 0.27                       |
|               |                          | 16                    | 10,800   | 500                | 0.05                      | 0.3                        | 10,800                                 | 600                | 0.03                      | 0.24                       | 10,700                                 | 490                | 0.03                      | 0.24                       | 8,000                                  | 245                | 0.03                      | 0.24                       |
|               |                          | 20                    | 8,650  | 375                | 0.035                     | 0.25                       | 8,650                                  | 450                | 0.02                      | 0.19                       | 8,560                                  | 370                | 0.02                      | 0.19                       | 6,400                                  | 185                | 0.02                      | 0.19                       |



## Note:

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when chattering and red-hot occur.
- Every coolant offers stable milling.

|   |
|---|
| <ul style="list-style-type: none"> <li>φ3mm Shank V Series</li> </ul>   |
| <ul style="list-style-type: none"> <li>UDC-PCD Series</li> </ul>  |
| <ul style="list-style-type: none"> <li>CBN Series</li> </ul>  |
| <ul style="list-style-type: none"> <li>Square</li> <li>Long Neck Square</li> </ul>  |
| <ul style="list-style-type: none"> <li>Radius</li> <li>Long Neck Radius</li> <li>Taper Neck Radius</li> </ul>             |
| <ul style="list-style-type: none"> <li>Ball / Long Shank Ball</li> <li>Long Neck Ball</li> <li>Taper Neck Ball</li> </ul> |
| <ul style="list-style-type: none"> <li>Taper</li> </ul>   |
| <ul style="list-style-type: none"> <li>Barrel</li> </ul>  |
| <ul style="list-style-type: none"> <li>Spiral V Cutter</li> </ul>   |
| <ul style="list-style-type: none"> <li>Drill</li> </ul>   |
| <ul style="list-style-type: none"> <li>Technical Data</li> </ul>  |



Size R0.05~R3

# HSLB

Super  
MG

HARD  
MAX

Shank Dia  
0/-0.005

Back Taper  
Geometry

Back taper geometry does not apply to R0.45 or below, and  $\ell_1 / D \leq 10$ .

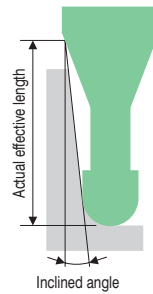
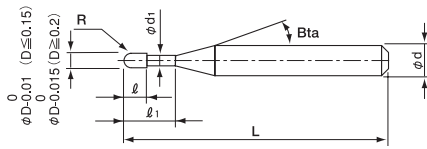
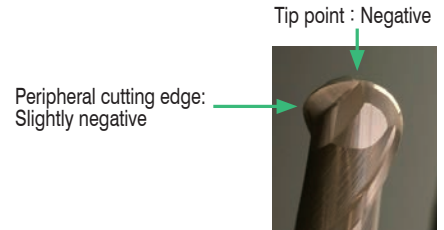
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●      | ●      | ○      | ○      |           |                 |          | ○      |          |                       | ○               | ○                     |                  |                                       |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

### Features

- Variable rake angle design**  
Optimized rake angles are designed from the ball tip to the peripheral cutting edge.
- HARDMAX coating**  
HARDMAX coating offers heat resistance, durability and lubricity at a high level.
- Suitable for various coolant types.**  
Every coolant offers stable milling.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy | Helix Angle |
|---------------------|--------------------|----------------------|-------------|
| R0.05 ~ R0.075      | 0/-0.01            | ±0.002               | 0°          |
| R0.1 ~ R3           | 0/-0.015           | ±0.005               | 30°         |

Long neck ball series for steels

| Number of Flutes | Model Number   | Features                                   | Ball tip design | Copper | Carbon Steels | Pre hardened Steels | HARDENED STEELS |          |          |          |          | Alloy Steels | Aluminum Alloys | Plastics | Titanium Heat Resistant Alloys | Page       |
|------------------|----------------|--|-----------------|--------|---------------|---------------------|-----------------|----------|----------|----------|----------|--------------|-----------------|----------|--------------------------------|------------|
|                  |                |  |                 |        |               |                     | ~ 50 HRC        | ~ 55 HRC | ~ 60 HRC | ~ 65 HRC | ~ 70 HRC |              |                 |          |                                |            |
| 2 Flutes         | HGLB           | Best suited for Hard Materials             | Super Negative  |        |               | ○                   | ●               | ●        | ●        | ★        | ★        |              |                 |          |                                | 460        |
|                  | HWLB           | For Hard Materials                         | Negative        | ○      | ○             | ●                   | ★               | ★        | ★        | ●        | ●        | ○            |                 |          | ○                              | 470        |
|                  | HSLB<br>HSLB-S | For Hard Materials<br>Multi-purpose        | Negative        | ○      | ○             | ●                   | ●               | ●        | ●        | ○        |          | ○            |                 |          | ○                              | 476<br>492 |
|                  | CSELB          | Multi-purpose<br>Excellent surface quality | Standard        | ●      | ●             | ●                   | ●               | ●        |          |          |          | ●            | ●               |          | ○                              | 496        |
|                  | CFLB           | Multi-purpose<br>Excellent surface quality | Positive        | ●      | ●             | ●                   | ●               | ●        |          |          |          | ●            | ●               | ○        | ●                              | 530        |



Total 325 models

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |      |       |       |      |      |      |      |      |
|-----------------|-----------------------|------------------------|-------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|-------------------------------------|------|-------|-------|------|------|------|------|------|
|                 |                       |                        |                   |                          |                           |                  |                         |                          | 30°                                 | 1°   | 1°30' | 2°    | 3°   |      |      |      |      |
| HSLB 2001-002   | RO.05                 | 0.2                    | 0.08              | 0.095                    | 11°                       | 45               | 4                       | 9,300                    | 0.21                                | 0.23 | 0.25  | 0.27  | 0.31 |      |      |      |      |
| HSLB 2001-003   |                       | 0.3                    |                   |                          |                           | 45               | 4                       | 9,300                    | 0.32                                | 0.35 | 0.37  | 0.40  | 0.45 |      |      |      |      |
| HSLB 2001-005   |                       | 0.5                    |                   |                          |                           | 45               | 4                       | 10,030                   | 0.54                                | 0.57 | 0.61  | 0.64  | 0.72 |      |      |      |      |
| HSLB 20015-003  | RO.075                | 0.3                    | 0.12              | 0.135                    | 11°                       | 45               | 4                       | 10,760                   | 0.36                                | 0.38 | 0.40  | 0.42  | 0.47 |      |      |      |      |
| HSLB 20015-005  |                       | 0.5                    |                   |                          |                           | 45               | 4                       | 11,400                   | 0.57                                | 0.60 | 0.63  | 0.67  | 0.75 |      |      |      |      |
| HSLB 20015-010  |                       | 1                      |                   |                          |                           | 45               | 4                       | 11,860                   | 1.10                                | 1.15 | 1.21  | 1.27  | 1.43 |      |      |      |      |
| HSLB 2002-003   | RO.1                  | 0.3                    | 0.16              | 0.19                     | 16°                       | 45               | 4                       | 6,470                    | 0.39                                | 0.42 | 0.44  | 0.46  | 0.50 |      |      |      |      |
| HSLB 2002-005   |                       | 0.5                    |                   |                          |                           | 45               | 4                       | 6,470                    | 0.61                                | 0.64 | 0.66  | 0.69  | 0.74 |      |      |      |      |
| HSLB 2002-005-6 |                       | 0.5                    |                   |                          |                           | 50               | 6                       | 9,030                    | 0.61                                | 0.64 | 0.66  | 0.69  | 0.74 |      |      |      |      |
| HSLB 2002-0075  |                       | 0.75                   |                   |                          |                           | 45               | 4                       | 6,470                    | 0.87                                | 0.91 | 0.95  | 0.98  | 1.05 |      |      |      |      |
| HSLB 2002-010   |                       | 1                      |                   |                          |                           | 45               | 4                       | 6,470                    | 1.13                                | 1.18 | 1.22  | 1.26  | 1.35 |      |      |      |      |
| HSLB 2002-010-6 |                       | 1                      |                   |                          |                           | 50               | 6                       | 9,030                    | 1.13                                | 1.18 | 1.22  | 1.26  | 1.35 |      |      |      |      |
| HSLB 2002-0125  |                       | 1.25                   |                   |                          |                           | 45               | 4                       | 7,020                    | 1.38                                | 1.44 | 1.49  | 1.54  | 1.65 |      |      |      |      |
| HSLB 2002-015   |                       | 1.5                    |                   |                          |                           | 45               | 4                       | 7,020                    | 1.64                                | 1.71 | 1.76  | 1.82  | 1.96 |      |      |      |      |
| HSLB 2002-015-6 |                       | 1.5                    |                   |                          |                           | 50               | 6                       | 9,800                    | 1.64                                | 1.71 | 1.76  | 1.82  | 1.96 |      |      |      |      |
| HSLB 2002-0175  |                       | 1.75                   |                   |                          |                           | 45               | 4                       | 7,750                    | 1.90                                | 1.97 | 2.04  | 2.11  | 2.26 |      |      |      |      |
| HSLB 2002-020   |                       | 2                      |                   |                          |                           | 45               | 4                       | 7,750                    | 2.16                                | 2.24 | 2.31  | 2.39  | 2.57 |      |      |      |      |
| HSLB 2002-020-6 |                       | 2                      |                   |                          |                           | 50               | 6                       | 10,820                   | 2.16                                | 2.24 | 2.31  | 2.39  | 2.57 |      |      |      |      |
| HSLB 2002-0225  |                       | 2.25                   |                   |                          |                           | 45               | 4                       | 8,480                    | 2.42                                | 2.51 | 2.59  | 2.68  | 2.87 |      |      |      |      |
| HSLB 2002-025   |                       | 2.5                    |                   |                          |                           | 45               | 4                       | 8,480                    | 2.68                                | 2.77 | 2.86  | 2.96  | 3.18 |      |      |      |      |
| HSLB 2002-030   |                       | 3                      |                   |                          |                           | 45               | 4                       | 9,120                    | 3.20                                | 3.30 | 3.41  | 3.53  | 3.79 |      |      |      |      |
| HSLB 2003-005   |                       | RO.15                  |                   |                          |                           | 0.5              | 0.24                    | 0.29                     | 16°                                 | 45   | 4     | 6,380 | 0.60 | 0.63 | 0.66 | 0.68 | 0.73 |
| HSLB 2003-006   |                       |                        |                   |                          |                           | 0.6              |                         |                          |                                     | 45   | 4     | 6,380 | 0.71 | 0.74 | 0.77 | 0.80 | 0.85 |
| HSLB 2003-0075  |                       |                        |                   |                          |                           | 0.75             |                         |                          |                                     | 45   | 4     | 6,380 | 0.87 | 0.91 | 0.94 | 0.97 | 1.04 |
| HSLB 2003-010   |                       |                        |                   |                          |                           | 1                |                         |                          |                                     | 45   | 4     | 6,380 | 1.13 | 1.18 | 1.22 | 1.26 | 1.34 |
| HSLB 2003-010-6 |                       |                        |                   |                          |                           | 1                |                         |                          |                                     | 50   | 6     | 8,660 | 1.13 | 1.18 | 1.22 | 1.26 | 1.34 |
| HSLB 2003-0125  | 1.25                  |                        | 45                | 4                        | 6,840                     | 1.38             |                         |                          |                                     | 1.43 | 1.48  | 1.53  | 1.64 |      |      |      |      |
| HSLB 2003-015   | 1.5                   |                        | 45                | 4                        | 6,840                     | 1.64             |                         |                          |                                     | 1.70 | 1.76  | 1.82  | 1.94 |      |      |      |      |
| HSLB 2003-015-6 | 1.5                   |                        | 50                | 6                        | 9,490                     | 1.64             |                         |                          |                                     | 1.70 | 1.76  | 1.82  | 1.94 |      |      |      |      |
| HSLB 2003-0175  | 1.75                  |                        | 45                | 4                        | 6,840                     | 1.90             |                         |                          |                                     | 1.97 | 2.03  | 2.10  | 2.25 |      |      |      |      |
| HSLB 2003-020   | 2                     |                        | 45                | 4                        | 6,840                     | 2.16             |                         |                          |                                     | 2.24 | 2.31  | 2.38  | 2.56 |      |      |      |      |
| HSLB 2003-020-6 | 2                     |                        | 50                | 6                        | 9,490                     | 2.16             |                         |                          |                                     | 2.24 | 2.31  | 2.38  | 2.56 |      |      |      |      |
| HSLB 2003-0225  | 2.25                  |                        | 45                | 4                        | 7,020                     | 2.42             |                         |                          |                                     | 2.50 | 2.58  | 2.67  | 2.86 |      |      |      |      |
| HSLB 2003-025   | 2.5                   |                        | 45                | 4                        | 7,020                     | 2.68             |                         |                          |                                     | 2.77 | 2.86  | 2.95  | 3.17 |      |      |      |      |
| HSLB 2003-030   | 3                     |                        | 45                | 4                        | 7,020                     | 3.20             |                         |                          |                                     | 3.30 | 3.41  | 3.52  | 3.78 |      |      |      |      |
| HSLB 2003-040   | 4                     |                        | 45                | 4                        | 7,300                     | 4.23             |                         |                          |                                     | 4.37 | 4.51  | 4.66  | 5.00 |      |      |      |      |
| HSLB 2003-050   | 5                     |                        | 45                | 4                        | 8,210                     | 5.26             |                         |                          |                                     | 5.43 | 5.61  | 5.80  | 6.23 |      |      |      |      |

Next Page ➡

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bia | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |      |       |      |      |
|-----------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|------|-------|------|------|
|                 |                       |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°   | 1°30' | 2°   | 3°   |
| HSLB 2004-005   | RO.2                  | 0.5                    | 0.32              | 0.39                     | 16°                   | 45               | 4                       | 4,380                    | 0.60                                | 0.63 | 0.65  | 0.68 | 0.72 |
| HSLB 2004-0075  |                       | 0.75                   |                   |                          |                       | 45               | 4                       | 4,380                    | 0.86                                | 0.90 | 0.93  | 0.96 | 1.03 |
| HSLB 2004-010   |                       | 1                      |                   |                          |                       | 45               | 4                       | 4,380                    | 1.13                                | 1.17 | 1.21  | 1.25 | 1.33 |
| HSLB 2004-010-6 |                       | 1                      |                   |                          |                       | 50               | 6                       | 6,380                    | 1.13                                | 1.17 | 1.21  | 1.25 | 1.33 |
| HSLB 2004-0125  |                       | 1.25                   |                   |                          |                       | 45               | 4                       | 4,470                    | 1.37                                | 1.43 | 1.48  | 1.52 | 1.63 |
| HSLB 2004-015   |                       | 1.5                    |                   |                          |                       | 45               | 4                       | 4,470                    | 1.64                                | 1.70 | 1.75  | 1.81 | 1.93 |
| HSLB 2004-015-6 |                       | 1.5                    |                   |                          |                       | 50               | 6                       | 6,470                    | 1.64                                | 1.70 | 1.75  | 1.81 | 1.93 |
| HSLB 2004-0175  |                       | 1.75                   |                   |                          |                       | 45               | 4                       | 4,560                    | 1.90                                | 1.97 | 2.03  | 2.09 | 2.24 |
| HSLB 2004-020   |                       | 2                      |                   |                          |                       | 45               | 4                       | 4,560                    | 2.16                                | 2.23 | 2.30  | 2.38 | 2.55 |
| HSLB 2004-020-6 |                       | 2                      |                   |                          |                       | 50               | 6                       | 6,660                    | 2.16                                | 2.23 | 2.30  | 2.38 | 2.55 |
| HSLB 2004-0225  |                       | 2.25                   |                   |                          |                       | 45               | 4                       | 4,740                    | 2.42                                | 2.50 | 2.58  | 2.66 | 2.85 |
| HSLB 2004-025   |                       | 2.5                    |                   |                          |                       | 45               | 4                       | 4,740                    | 2.68                                | 2.76 | 2.85  | 2.95 | 3.16 |
| HSLB 2004-025-6 |                       | 2.5                    |                   |                          |                       | 50               | 6                       | 6,840                    | 2.68                                | 2.76 | 2.85  | 2.95 | 3.16 |
| HSLB 2004-030   |                       | 3                      |                   |                          |                       | 45               | 4                       | 5,020                    | 3.20                                | 3.30 | 3.40  | 3.52 | 3.77 |
| HSLB 2004-030-6 |                       | 3                      |                   |                          |                       | 50               | 6                       | 7,300                    | 3.20                                | 3.30 | 3.40  | 3.52 | 3.77 |
| HSLB 2004-035   |                       | 3.5                    |                   |                          |                       | 45               | 4                       | 5,470                    | 3.71                                | 3.83 | 3.95  | 4.09 | 4.38 |
| HSLB 2004-040   |                       | 4                      |                   |                          |                       | 45               | 4                       | 5,470                    | 4.23                                | 4.36 | 4.50  | 4.66 | 4.99 |
| HSLB 2004-040-6 |                       | 4                      |                   |                          |                       | 50               | 6                       | 7,440                    | 4.23                                | 4.36 | 4.50  | 4.66 | 4.99 |
| HSLB 2004-045   |                       | 4.5                    |                   |                          |                       | 45               | 4                       | 5,740                    | 4.74                                | 4.89 | 5.05  | 5.22 | 5.61 |
| HSLB 2004-050   |                       | 5                      |                   |                          |                       | 45               | 4                       | 5,740                    | 5.26                                | 5.43 | 5.60  | 5.79 | 6.22 |
| HSLB 2004-060   | 6                     | 45                     | 4                 | 6,660                    | 6.29                  | 6.49             | 6.70                    | 6.93                     | 7.44                                |      |       |      |      |
| HSLB 2005-010   | RO.25                 | 1                      | 0.4               | 0.49                     | 16°                   | 45               | 4                       | 4,380                    | 1.12                                | 1.17 | 1.21  | 1.24 | 1.32 |
| HSLB 2005-0125  |                       | 1.25                   |                   |                          |                       | 45               | 4                       | 4,380                    | 1.37                                | 1.43 | 1.47  | 1.52 | 1.62 |
| HSLB 2005-015   |                       | 1.5                    |                   |                          |                       | 45               | 4                       | 4,380                    | 1.63                                | 1.70 | 1.75  | 1.80 | 1.92 |
| HSLB 2005-015-6 |                       | 1.5                    |                   |                          |                       | 50               | 6                       | 6,380                    | 1.63                                | 1.70 | 1.75  | 1.80 | 1.92 |
| HSLB 2005-0175  |                       | 1.75                   |                   |                          |                       | 45               | 4                       | 4,380                    | 1.90                                | 1.96 | 2.02  | 2.09 | 2.23 |
| HSLB 2005-020   |                       | 2                      |                   |                          |                       | 45               | 4                       | 4,380                    | 2.16                                | 2.23 | 2.30  | 2.37 | 2.54 |
| HSLB 2005-020-6 |                       | 2                      |                   |                          |                       | 50               | 6                       | 6,380                    | 2.16                                | 2.23 | 2.30  | 2.37 | 2.54 |
| HSLB 2005-0225  |                       | 2.25                   |                   |                          |                       | 45               | 4                       | 4,380                    | 2.42                                | 2.50 | 2.57  | 2.66 | 2.84 |
| HSLB 2005-025   |                       | 2.5                    |                   |                          |                       | 45               | 4                       | 4,380                    | 2.68                                | 2.76 | 2.85  | 2.94 | 3.15 |
| HSLB 2005-025-6 |                       | 2.5                    |                   |                          |                       | 50               | 6                       | 6,380                    | 2.68                                | 2.76 | 2.85  | 2.94 | 3.15 |
| HSLB 2005-030   |                       | 3                      |                   |                          |                       | 45               | 4                       | 4,380                    | 3.20                                | 3.29 | 3.40  | 3.51 | 3.76 |
| HSLB 2005-030-6 |                       | 3                      |                   |                          |                       | 50               | 6                       | 6,380                    | 3.20                                | 3.29 | 3.40  | 3.51 | 3.76 |
| HSLB 2005-035   |                       | 3.5                    |                   |                          |                       | 45               | 4                       | 4,380                    | 3.71                                | 3.83 | 3.95  | 4.08 | 4.37 |
| HSLB 2005-040   |                       | 4                      |                   |                          |                       | 45               | 4                       | 4,380                    | 4.23                                | 4.36 | 4.50  | 4.65 | 4.98 |
| HSLB 2005-040-6 |                       | 4                      |                   |                          |                       | 50               | 6                       | 6,380                    | 4.23                                | 4.36 | 4.50  | 4.65 | 4.98 |
| HSLB 2005-045   |                       | 4.5                    |                   |                          |                       | 45               | 4                       | 4,470                    | 4.74                                | 4.89 | 5.05  | 5.22 | 5.59 |
| HSLB 2005-050   |                       | 5                      |                   |                          |                       | 45               | 4                       | 4,470                    | 5.26                                | 5.42 | 5.60  | 5.79 | 6.21 |
| HSLB 2005-055   |                       | 5.5                    |                   |                          |                       | 45               | 4                       | 4,560                    | 5.77                                | 5.96 | 6.15  | 6.36 | 6.82 |
| HSLB 2005-060   |                       | 6                      |                   |                          |                       | 45               | 4                       | 4,560                    | 6.29                                | 6.49 | 6.70  | 6.93 | 7.43 |
| HSLB 2005-070   |                       | 7                      |                   |                          |                       | 45               | 4                       | 5,470                    | 7.32                                | 7.55 | 7.80  | 8.06 | 8.65 |
| HSLB 2005-080   | 8                     | 45                     | 4                 | 5,470                    | 8.35                  | 8.62             | 8.90                    | 9.20                     | 9.88                                |      |       |      |      |
| HSLB 2005-090   | 9                     | 45                     | 4                 | 6,380                    | 9.38                  | 9.68             | 10.00                   | 10.34                    | 11.10                               |      |       |      |      |
| HSLB 2005-100   | 10                    | 50                     | 4                 | 6,800                    | 10.42                 | 10.75            | 11.10                   | 11.48                    | 12.32                               |      |       |      |      |

- $\phi 3\text{mm}$  Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |       |       |      |      |      |      |
|-----------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|-------|-------|------|------|------|------|
|                 |                       |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°    | 3°    |      |      |      |      |
| HSLB 2006-010   | R0.3                  | 1                      | 0.48              | 0.59                     | 16°                   | 45               | 4                       | 3,740                    | 1.12                                | 1.16  | 1.20  | 1.24  | 1.31  |      |      |      |      |
| HSLB 2006-0125  |                       | 1.25                   |                   |                          |                       | 45               | 4                       | 3,380                    | 1.37                                | 1.42  | 1.47  | 1.51  | 1.61  |      |      |      |      |
| HSLB 2006-015   |                       | 1.5                    |                   |                          |                       | 45               | 4                       | 3,380                    | 1.63                                | 1.69  | 1.74  | 1.80  | 1.91  |      |      |      |      |
| HSLB 2006-015-6 |                       | 1.5                    |                   |                          |                       | 50               | 6                       | 5,100                    | 1.63                                | 1.69  | 1.74  | 1.80  | 1.91  |      |      |      |      |
| HSLB 2006-0175  |                       | 1.75                   |                   |                          |                       | 45               | 4                       | 3,380                    | 1.89                                | 1.96  | 2.02  | 2.08  | 2.22  |      |      |      |      |
| HSLB 2006-020   |                       | 2                      |                   |                          |                       | 45               | 4                       | 3,380                    | 2.15                                | 2.23  | 2.29  | 2.36  | 2.52  |      |      |      |      |
| HSLB 2006-020-6 |                       | 2                      |                   |                          |                       | 50               | 6                       | 5,100                    | 2.15                                | 2.23  | 2.29  | 2.36  | 2.52  |      |      |      |      |
| HSLB 2006-0225  |                       | 2.25                   |                   |                          |                       | 45               | 4                       | 3,460                    | 2.42                                | 2.49  | 2.57  | 2.65  | 2.83  |      |      |      |      |
| HSLB 2006-025   |                       | 2.5                    |                   |                          |                       | 45               | 4                       | 3,460                    | 2.67                                | 2.76  | 2.84  | 2.93  | 3.14  |      |      |      |      |
| HSLB 2006-025-6 |                       | 2.5                    |                   |                          |                       | 50               | 6                       | 5,100                    | 2.67                                | 2.76  | 2.84  | 2.93  | 3.14  |      |      |      |      |
| HSLB 2006-030   |                       | 3                      |                   |                          |                       | 45               | 4                       | 3,460                    | 3.19                                | 3.29  | 3.39  | 3.50  | 3.75  |      |      |      |      |
| HSLB 2006-030-6 |                       | 3                      |                   |                          |                       | 50               | 6                       | 5,200                    | 3.19                                | 3.29  | 3.39  | 3.50  | 3.75  |      |      |      |      |
| HSLB 2006-035   |                       | 3.5                    |                   |                          |                       | 45               | 4                       | 3,560                    | 3.71                                | 3.82  | 3.94  | 4.07  | 4.36  |      |      |      |      |
| HSLB 2006-040   |                       | 4                      |                   |                          |                       | 45               | 4                       | 3,560                    | 4.23                                | 4.36  | 4.49  | 4.64  | 4.97  |      |      |      |      |
| HSLB 2006-040-6 |                       | 4                      |                   |                          |                       | 50               | 6                       | 5,380                    | 4.23                                | 4.36  | 4.49  | 4.64  | 4.97  |      |      |      |      |
| HSLB 2006-045   |                       | 4.5                    |                   |                          |                       | 45               | 4                       | 3,560                    | 4.74                                | 4.89  | 5.04  | 5.21  | 5.58  |      |      |      |      |
| HSLB 2006-050   |                       | 5                      |                   |                          |                       | 45               | 4                       | 3,560                    | 5.26                                | 5.42  | 5.59  | 5.78  | 6.20  |      |      |      |      |
| HSLB 2006-050-6 |                       | 5                      |                   |                          |                       | 50               | 6                       | 5,380                    | 5.26                                | 5.42  | 5.59  | 5.78  | 6.20  |      |      |      |      |
| HSLB 2006-055   |                       | 5.5                    |                   |                          |                       | 45               | 4                       | 3,560                    | 5.77                                | 5.95  | 6.14  | 6.35  | 6.81  |      |      |      |      |
| HSLB 2006-060   |                       | 6                      |                   |                          |                       | 45               | 4                       | 3,560                    | 6.29                                | 6.49  | 6.69  | 6.92  | 7.42  |      |      |      |      |
| HSLB 2006-060-6 |                       | 6                      |                   |                          |                       | 50               | 6                       | 5,380                    | 6.29                                | 6.49  | 6.69  | 6.92  | 7.42  |      |      |      |      |
| HSLB 2006-065   |                       | 6.5                    |                   |                          |                       | 45               | 4                       | 4,020                    | 6.80                                | 7.02  | 7.25  | 7.49  | 8.03  |      |      |      |      |
| HSLB 2006-070   |                       | 7                      |                   |                          |                       | 45               | 4                       | 4,020                    | 7.32                                | 7.55  | 7.80  | 8.06  | 8.64  |      |      |      |      |
| HSLB 2006-080   |                       | 8                      |                   |                          |                       | 45               | 4                       | 4,740                    | 8.35                                | 8.61  | 8.90  | 9.20  | 9.87  |      |      |      |      |
| HSLB 2006-080-6 |                       | 8                      |                   |                          |                       | 50               | 6                       | 6,840                    | 8.35                                | 8.61  | 8.90  | 9.20  | 9.87  |      |      |      |      |
| HSLB 2006-090   |                       | 9                      |                   |                          |                       | 45               | 4                       | 5,020                    | 9.38                                | 9.68  | 10.00 | 10.34 | 11.09 |      |      |      |      |
| HSLB 2006-100   |                       | 10                     |                   |                          |                       | 50               | 4                       | 4,830                    | 10.41                               | 10.74 | 11.10 | 11.47 | 12.31 |      |      |      |      |
| HSLB 2006-100-6 |                       | 10                     |                   |                          |                       | 50               | 6                       | 7,300                    | 10.41                               | 10.74 | 11.10 | 11.47 | 12.31 |      |      |      |      |
| HSLB 2006-120   |                       | 12                     |                   |                          |                       | 50               | 4                       | 5,470                    | 12.48                               | 12.87 | 13.30 | 13.75 | 14.76 |      |      |      |      |
| HSLB 2007-020   |                       | R0.35                  |                   |                          |                       | 2                | 0.56                    | 0.69                     | 16°                                 | 45    | 4     | 3,380 | 2.15  | 2.22 | 2.29 | 2.36 | 2.51 |
| HSLB 2007-040   |                       |                        |                   |                          |                       | 4                |                         |                          |                                     | 45    | 4     | 3,560 | 4.22  | 4.35 | 4.49 | 4.63 | 4.96 |
| HSLB 2007-060   |                       |                        |                   |                          |                       | 6                |                         |                          |                                     | 45    | 4     | 3,560 | 6.29  | 6.48 | 6.69 | 6.91 | 7.41 |
| HSLB 2007-080   | 8                     |                        | 45                | 4                        | 3,560                 | 8.35             |                         |                          |                                     | 8.61  | 8.89  | 9.19  | 9.86  |      |      |      |      |
| HSLB 2008-020   | R0.4                  | 2                      | 0.64              | 0.79                     | 16°                   | 45               | 4                       | 3,380                    | 2.15                                | 2.22  | 2.28  | 2.35  | 2.50  |      |      |      |      |
| HSLB 2008-020-6 |                       | 2                      |                   |                          |                       | 50               | 6                       | 5,100                    | 2.15                                | 2.22  | 2.28  | 2.35  | 2.50  |      |      |      |      |
| HSLB 2008-030   |                       | 3                      |                   |                          |                       | 45               | 4                       | 3,560                    | 3.19                                | 3.28  | 3.38  | 3.49  | 3.73  |      |      |      |      |
| HSLB 2008-030-6 |                       | 3                      |                   |                          |                       | 50               | 6                       | 5,380                    | 3.19                                | 3.28  | 3.38  | 3.49  | 3.73  |      |      |      |      |
| HSLB 2008-040   |                       | 4                      |                   |                          |                       | 45               | 4                       | 3,560                    | 4.22                                | 4.35  | 4.48  | 4.63  | 4.95  |      |      |      |      |
| HSLB 2008-040-6 |                       | 4                      |                   |                          |                       | 50               | 6                       | 5,380                    | 4.22                                | 4.35  | 4.48  | 4.63  | 4.95  |      |      |      |      |
| HSLB 2008-050   |                       | 5                      |                   |                          |                       | 45               | 4                       | 3,560                    | 5.25                                | 5.41  | 5.58  | 5.77  | 6.17  |      |      |      |      |
| HSLB 2008-060   |                       | 6                      |                   |                          |                       | 45               | 4                       | 3,560                    | 6.29                                | 6.48  | 6.68  | 6.91  | 7.40  |      |      |      |      |
| HSLB 2008-060-6 |                       | 6                      |                   |                          |                       | 50               | 6                       | 5,380                    | 6.29                                | 6.48  | 6.68  | 6.91  | 7.40  |      |      |      |      |
| HSLB 2008-070   |                       | 7                      |                   |                          |                       | 45               | 4                       | 3,560                    | 7.32                                | 7.54  | 7.79  | 8.04  | 8.62  |      |      |      |      |
| HSLB 2008-080   |                       | 8                      |                   |                          |                       | 45               | 4                       | 3,560                    | 8.35                                | 8.61  | 8.89  | 9.18  | 9.84  |      |      |      |      |
| HSLB 2008-080-6 |                       | 8                      |                   |                          |                       | 50               | 6                       | 5,380                    | 8.35                                | 8.61  | 8.89  | 9.18  | 9.84  |      |      |      |      |
| HSLB 2008-090   |                       | 9                      |                   |                          |                       | 45               | 4                       | 4,740                    | 9.38                                | 9.67  | 9.99  | 10.32 | 11.07 |      |      |      |      |
| HSLB 2008-100   |                       | 10                     |                   |                          |                       | 50               | 4                       | 4,740                    | 10.41                               | 10.74 | 11.09 | 11.46 | 12.29 |      |      |      |      |
| HSLB 2008-100-6 |                       | 10                     |                   |                          |                       | 50               | 6                       | 6,840                    | 10.41                               | 10.74 | 11.09 | 11.46 | 12.29 |      |      |      |      |
| HSLB 2008-120   |                       | 12                     |                   |                          |                       | 50               | 4                       | 5,840                    | 12.47                               | 12.87 | 13.29 | 13.74 | 14.74 |      |      |      |      |
| HSLB 2008-160   |                       | 16                     |                   |                          |                       | 50               | 4                       | 7,990                    | 16.60                               | 17.13 | 17.69 | 18.29 | 19.63 |      |      |      |      |

Ø3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bia | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |       |       |
|-----------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|-------|-------|
|                 |                       |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°    | 3°    |
| HSLB 2009-020   | RO.45                 | 2                      | 0.72              | 0.89                     | 16°                   | 45               | 4                       | 3,380                    | 2.15                                | 2.22  | 2.28  | 2.34  | 2.49  |
| HSLB 2009-040   |                       | 4                      |                   |                          |                       | 45               | 4                       | 3,560                    | 4.22                                | 4.35  | 4.48  | 4.62  | 4.94  |
| HSLB 2009-060   |                       | 6                      |                   |                          |                       | 45               | 4                       | 3,560                    | 6.28                                | 6.48  | 6.68  | 6.90  | 7.39  |
| HSLB 2009-080   |                       | 8                      |                   |                          |                       | 45               | 4                       | 3,560                    | 8.35                                | 8.61  | 8.88  | 9.18  | 9.83  |
| HSLB 2009-100   |                       | 10                     |                   |                          |                       | 45               | 4                       | 4,740                    | 10.41                               | 10.73 | 11.08 | 11.45 | 12.28 |
| HSLB 2009-120   |                       | 12                     |                   |                          |                       | 50               | 4                       | 5,840                    | 12.47                               | 12.86 | 13.28 | 13.73 | 14.73 |
| HSLB 2009-140   |                       | 14                     |                   |                          |                       | 50               | 4                       | 6,770                    | 14.54                               | 14.99 | 15.48 | 16.01 | 17.18 |
| HSLB 2009-160   |                       | 16                     |                   |                          |                       | 50               | 4                       | 7,990                    | 16.60                               | 17.12 | 17.68 | 18.29 | 19.62 |
| HSLB 2009-180   |                       | 18                     |                   |                          |                       | 55               | 4                       | 7,990                    | 18.66                               | 19.25 | 19.89 | 20.56 | 22.07 |
| HSLB 2010-020   | RO.5                  | 2                      | 0.8               | 0.98                     | 16°                   | 45               | 4                       | 2,820                    | 2.16                                | 2.22  | 2.28  | 2.35  | 2.49  |
| HSLB 2010-025   |                       | 2.5                    |                   |                          |                       | 45               | 4                       | 2,820                    | 2.68                                | 2.76  | 2.83  | 2.92  | 3.11  |
| HSLB 2010-030   |                       | 3                      |                   |                          |                       | 45               | 4                       | 2,820                    | 3.20                                | 3.29  | 3.38  | 3.49  | 3.72  |
| HSLB 2010-030-6 |                       | 3                      |                   |                          |                       | 50               | 6                       | 4,470                    | 3.20                                | 3.29  | 3.38  | 3.49  | 3.72  |
| HSLB 2010-040   |                       | 4                      |                   |                          |                       | 45               | 4                       | 3,190                    | 4.23                                | 4.35  | 4.49  | 4.63  | 4.94  |
| HSLB 2010-040-6 |                       | 4                      |                   |                          |                       | 50               | 6                       | 4,930                    | 4.23                                | 4.35  | 4.49  | 4.63  | 4.94  |
| HSLB 2010-050   |                       | 5                      |                   |                          |                       | 45               | 4                       | 3,190                    | 5.26                                | 5.42  | 5.59  | 5.77  | 6.16  |
| HSLB 2010-050-6 |                       | 5                      |                   |                          |                       | 50               | 6                       | 4,930                    | 5.26                                | 5.42  | 5.59  | 5.77  | 6.16  |
| HSLB 2010-060   |                       | 6                      |                   |                          |                       | 45               | 4                       | 3,460                    | 6.29                                | 6.48  | 6.69  | 6.90  | 7.39  |
| HSLB 2010-060-6 |                       | 6                      |                   |                          |                       | 50               | 6                       | 5,200                    | 6.29                                | 6.48  | 6.69  | 6.90  | 7.39  |
| HSLB 2010-070   |                       | 7                      |                   |                          |                       | 45               | 4                       | 3,460                    | 7.32                                | 7.55  | 7.79  | 8.04  | 8.61  |
| HSLB 2010-070-6 |                       | 7                      |                   |                          |                       | 50               | 6                       | 5,200                    | 7.32                                | 7.55  | 7.79  | 8.04  | 8.61  |
| HSLB 2010-080   |                       | 8                      |                   |                          |                       | 45               | 4                       | 3,460                    | 8.36                                | 8.61  | 8.89  | 9.18  | 9.84  |
| HSLB 2010-080-6 |                       | 8                      |                   |                          |                       | 50               | 6                       | 5,200                    | 8.36                                | 8.61  | 8.89  | 9.18  | 9.84  |
| HSLB 2010-090   |                       | 9                      |                   |                          |                       | 45               | 4                       | 3,460                    | 9.39                                | 9.68  | 9.99  | 10.32 | 11.06 |
| HSLB 2010-100   |                       | 10                     |                   |                          |                       | 45               | 4                       | 3,460                    | 10.42                               | 10.74 | 11.09 | 11.46 | 12.28 |
| HSLB 2010-100-6 |                       | 10                     |                   |                          |                       | 50               | 6                       | 5,200                    | 10.42                               | 10.74 | 11.09 | 11.46 | 12.28 |
| HSLB 2010-120   |                       | 12                     |                   |                          |                       | 45               | 4                       | 3,460                    | 12.48                               | 12.87 | 13.29 | 13.74 | 14.73 |
| HSLB 2010-120-6 |                       | 12                     |                   |                          |                       | 50               | 6                       | 5,200                    | 12.48                               | 12.87 | 13.29 | 13.74 | 14.73 |
| HSLB 2010-140   |                       | 14                     |                   |                          |                       | 50               | 4                       | 4,020                    | 14.54                               | 15.00 | 15.49 | 16.01 | 17.18 |
| HSLB 2010-140-6 |                       | 14                     |                   |                          |                       | 60               | 6                       | 5,660                    | 14.54                               | 15.00 | 15.49 | 16.01 | 17.18 |
| HSLB 2010-160   |                       | 16                     |                   |                          |                       | 50               | 4                       | 4,740                    | 16.61                               | 17.13 | 17.69 | 18.29 | 19.62 |
| HSLB 2010-160-6 | 16                    | 60                     | 6                 | 6,840                    | 16.61                 | 17.13            | 17.69                   | 18.29                    | 19.62                               |       |       |       |       |
| HSLB 2010-180   | 18                    | 55                     | 4                 | 4,740                    | 18.67                 | 19.26            | 19.89                   | 20.57                    | 22.07                               |       |       |       |       |
| HSLB 2010-200   | 20                    | 55                     | 4                 | 5,740                    | 20.73                 | 21.39            | 22.09                   | 22.85                    | 24.52                               |       |       |       |       |
| HSLB 2010-200-6 | 20                    | 70                     | 6                 | 8,120                    | 20.73                 | 21.39            | 22.09                   | 22.85                    | 24.52                               |       |       |       |       |
| HSLB 2010-220-6 | 22                    | 70                     | 6                 | 8,480                    | 22.80                 | 23.52            | 24.29                   | 25.12                    | 26.97                               |       |       |       |       |
| HSLB 2012-025   | RO.6                  | 2.5                    | 0.96              | 1.19                     | 16°                   | 45               | 4                       | 4,290                    | 2.54                                | 2.60  | 2.67  | 2.74  | 2.91  |
| HSLB 2012-040   |                       | 4                      |                   |                          |                       | 45               | 4                       | 4,290                    | 4.08                                | 4.20  | 4.32  | 4.45  | 4.75  |
| HSLB 2012-060   |                       | 6                      |                   |                          |                       | 45               | 4                       | 4,650                    | 6.15                                | 6.33  | 6.52  | 6.73  | 7.19  |
| HSLB 2012-060-6 |                       | 6                      |                   |                          |                       | 50               | 6                       | 6,620                    | 6.15                                | 6.33  | 6.52  | 6.73  | 7.19  |
| HSLB 2012-080   |                       | 8                      |                   |                          |                       | 45               | 4                       | 4,650                    | 8.21                                | 8.46  | 8.72  | 9.01  | 9.64  |
| HSLB 2012-080-6 |                       | 8                      |                   |                          |                       | 50               | 6                       | 6,620                    | 8.21                                | 8.46  | 8.72  | 9.01  | 9.64  |
| HSLB 2012-100   |                       | 10                     |                   |                          |                       | 45               | 4                       | 4,650                    | 10.27                               | 10.59 | 10.92 | 11.28 | 12.09 |
| HSLB 2012-100-6 |                       | 10                     |                   |                          |                       | 50               | 6                       | 6,620                    | 10.27                               | 10.59 | 10.92 | 11.28 | 12.09 |
| HSLB 2012-120   |                       | 12                     |                   |                          |                       | 45               | 4                       | 4,650                    | 12.33                               | 12.72 | 13.12 | 13.56 | 14.54 |
| HSLB 2012-120-6 |                       | 12                     |                   |                          |                       | 50               | 6                       | 6,620                    | 12.33                               | 12.72 | 13.12 | 13.56 | 14.54 |
| HSLB 2012-140   |                       | 14                     |                   |                          |                       | 50               | 4                       | 5,020                    | 14.40                               | 14.85 | 15.33 | 15.84 | 16.98 |
| HSLB 2012-160   |                       | 16                     |                   |                          |                       | 50               | 4                       | 5,470                    | 16.46                               | 16.98 | 17.53 | 18.12 | 19.43 |
| HSLB 2012-160-6 |                       | 16                     |                   |                          |                       | 60               | 6                       | 7,530                    | 16.46                               | 16.98 | 17.53 | 18.12 | 19.43 |
| HSLB 2012-180   |                       | 18                     |                   |                          |                       | 55               | 4                       | 5,930                    | 18.52                               | 19.11 | 19.73 | 20.39 | 21.88 |
| HSLB 2012-200   |                       | 20                     |                   |                          |                       | 60               | 4                       | 5,930                    | 20.58                               | 21.23 | 21.93 | 22.67 | 24.33 |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |                 |                 |
|-----------------|-----------------------|------------------------|-------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|-----------------|-----------------|
|                 |                       |                        |                   |                          |                           |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°              | 3°              |
| HSLB 2014-060   | R0.7                  | 6                      | 1.12              | 1.37                     | 16°                       | 45               | 4                       | 4,020                    | 6.18                                | 6.36  | 6.55  | 6.76            | 7.22            |
| HSLB 2014-080   |                       | 8                      |                   |                          |                           | 45               | 4                       | 4,020                    | 8.24                                | 8.49  | 8.75  | 9.03            | 9.66            |
| HSLB 2014-120   |                       | 12                     |                   |                          |                           | 45               | 4                       | 4,020                    | 12.37                               | 12.75 | 13.15 | 13.59           | 14.56           |
| HSLB 2014-160   |                       | 16                     |                   |                          |                           | 50               | 4                       | 4,020                    | 16.49                               | 17.01 | 17.56 | 18.14           | 19.45           |
| HSLB 2015-030   | R0.75                 | 3                      | 1.2               | 1.47                     | 16°                       | 45               | 4                       | 3,280                    | 3.08                                | 3.16  | 3.24  | 3.33            | 3.53            |
| HSLB 2015-040   |                       | 4                      |                   |                          |                           | 45               | 4                       | 3,280                    | 4.11                                | 4.23  | 4.34  | 4.47            | 4.76            |
| HSLB 2015-060   |                       | 6                      |                   |                          |                           | 45               | 4                       | 3,280                    | 6.18                                | 6.35  | 6.55  | 6.75            | 7.20            |
| HSLB 2015-060-6 |                       | 6                      |                   |                          |                           | 50               | 6                       | 5,290                    | 6.18                                | 6.35  | 6.55  | 6.75            | 7.20            |
| HSLB 2015-080   |                       | 8                      |                   |                          |                           | 45               | 4                       | 3,460                    | 8.24                                | 8.48  | 8.75  | 9.03            | 9.65            |
| HSLB 2015-080-6 |                       | 8                      |                   |                          |                           | 50               | 6                       | 5,290                    | 8.24                                | 8.48  | 8.75  | 9.03            | 9.65            |
| HSLB 2015-100   |                       | 10                     |                   |                          |                           | 45               | 4                       | 3,740                    | 10.30                               | 10.61 | 10.95 | 11.30           | 12.10           |
| HSLB 2015-100-6 |                       | 10                     |                   |                          |                           | 50               | 6                       | 5,290                    | 10.30                               | 10.61 | 10.95 | 11.30           | 12.10           |
| HSLB 2015-120   |                       | 12                     |                   |                          |                           | 45               | 4                       | 4,020                    | 12.37                               | 12.74 | 13.15 | 13.58           | 14.55           |
| HSLB 2015-120-6 |                       | 12                     |                   |                          |                           | 50               | 6                       | 6,020                    | 12.37                               | 12.74 | 13.15 | 13.58           | 14.55           |
| HSLB 2015-140   |                       | 14                     |                   |                          |                           | 50               | 4                       | 4,020                    | 14.43                               | 14.87 | 15.35 | 15.86           | 16.99           |
| HSLB 2015-160   |                       | 16                     |                   |                          |                           | 50               | 4                       | 4,020                    | 16.49                               | 17.00 | 17.55 | 18.14           | 19.44           |
| HSLB 2015-160-6 |                       | 16                     |                   |                          |                           | 60               | 6                       | 6,020                    | 16.49                               | 17.00 | 17.55 | 18.14           | 19.44           |
| HSLB 2015-180   |                       | 18                     |                   |                          |                           | 55               | 4                       | 4,020                    | 18.55                               | 19.13 | 19.75 | 20.41           | 21.89           |
| HSLB 2015-200   |                       | 20                     |                   |                          |                           | 55               | 4                       | 4,020                    | 20.62                               | 21.26 | 21.95 | 22.69           | 24.34           |
| HSLB 2015-200-6 |                       | 20                     |                   |                          |                           | 60               | 6                       | 6,020                    | 20.62                               | 21.26 | 21.95 | 22.69           | 24.34           |
| HSLB 2015-220   |                       | 22                     |                   |                          |                           | 55               | 4                       | 4,020                    | 22.68                               | 23.39 | 24.15 | 24.97           | No Interference |
| HSLB 2015-250   |                       | 25                     |                   |                          |                           | 65               | 4                       | 5,600                    | 25.77                               | 26.59 | 27.45 | 28.38           | No Interference |
| HSLB 2015-300   |                       | 30                     |                   |                          |                           | 70               | 4                       | 6,570                    | 30.93                               | 31.91 | 32.96 | 34.08           | No Interference |
| HSLB 2016-040   |                       | R0.8                   |                   |                          |                           | 4                | 1.28                    | 1.58                     | 16°                                 | 45    | 4     | 4,560           | 4.09            |
| HSLB 2016-080   | 8                     |                        | 45                | 4                        | 4,650                     | 8.22             |                         |                          |                                     | 8.46  | 8.72  | 9.00            | 9.62            |
| HSLB 2016-120   | 12                    |                        | 45                | 4                        | 4,650                     | 12.35            |                         |                          |                                     | 12.72 | 13.12 | 13.55           | 14.51           |
| HSLB 2016-160   | 16                    |                        | 50                | 4                        | 4,650                     | 16.47            |                         |                          |                                     | 16.98 | 17.53 | 18.11           | 19.41           |
| HSLB 2016-200   | 20                    |                        | 55                | 4                        | 4,650                     | 20.60            |                         |                          |                                     | 21.24 | 21.93 | 22.66           | No Interference |
| HSLB 2018-040   | R0.9                  | 4                      | 1.44              | 1.78                     | 16°                       | 45               | 4                       | 3,800                    | 4.09                                | 4.20  | 4.31  | 4.43            | 4.70            |
| HSLB 2018-060   |                       | 6                      |                   |                          |                           | 45               | 4                       | 3,800                    | 6.15                                | 6.33  | 6.51  | 6.71            | 7.15            |
| HSLB 2018-080   |                       | 8                      |                   |                          |                           | 45               | 4                       | 4,020                    | 8.22                                | 8.46  | 8.71  | 8.99            | 9.60            |
| HSLB 2018-100   |                       | 10                     |                   |                          |                           | 45               | 4                       | 4,020                    | 10.28                               | 10.59 | 10.91 | 11.26           | 12.04           |
| HSLB 2018-120   |                       | 12                     |                   |                          |                           | 45               | 4                       | 4,020                    | 12.34                               | 12.72 | 13.11 | 13.54           | 14.49           |
| HSLB 2018-160   |                       | 16                     |                   |                          |                           | 50               | 4                       | 4,020                    | 16.47                               | 16.97 | 17.52 | 18.10           | 19.39           |
| HSLB 2018-180   |                       | 18                     |                   |                          |                           | 55               | 4                       | 4,020                    | 18.53                               | 19.10 | 19.72 | 20.37           | 21.83           |
| HSLB 2018-200   |                       | 20                     |                   |                          |                           | 55               | 4                       | 4,020                    | 20.59                               | 21.23 | 21.92 | 22.65           | No Interference |
| HSLB 2018-220   |                       | 22                     |                   |                          |                           | 60               | 4                       | 5,500                    | 22.66                               | 23.36 | 24.12 | 24.93           | No Interference |
| HSLB 2018-250   |                       | 25                     |                   |                          |                           | 65               | 4                       | 5,600                    | 25.75                               | 26.56 | 27.42 | 28.34           | No Interference |
| HSLB 2018-300   |                       | 30                     |                   |                          |                           | 70               | 4                       | 6,340                    | 30.91                               | 31.88 | 32.92 | No Interference | No Interference |

Next Page →

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bia | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |                 |                 |                 |
|-----------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-----------------|-----------------|-----------------|
|                 |                       |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°    | 1°30'           | 2°              | 3°              |
| HSLB 2020-030   | R1                    | 3                      | 1.6               | 1.98                     | 16°                   | 45               | 4                       | 2,820                    | 3.06                                | 3.13  | 3.20            | 3.28            | 3.46            |
| HSLB 2020-040   |                       | 4                      |                   |                          |                       | 45               | 4                       | 2,820                    | 4.09                                | 4.19  | 4.30            | 4.42            | 4.68            |
| HSLB 2020-040-6 |                       | 4                      |                   |                          |                       | 50               | 6                       | 4,470                    | 4.09                                | 4.19  | 4.30            | 4.42            | 4.68            |
| HSLB 2020-060   |                       | 6                      |                   |                          |                       | 45               | 4                       | 3,190                    | 6.15                                | 6.32  | 6.50            | 6.70            | 7.13            |
| HSLB 2020-060-6 |                       | 6                      |                   |                          |                       | 50               | 6                       | 4,830                    | 6.15                                | 6.32  | 6.50            | 6.70            | 7.13            |
| HSLB 2020-080   |                       | 8                      |                   |                          |                       | 45               | 4                       | 3,460                    | 8.21                                | 8.45  | 8.70            | 8.97            | 9.58            |
| HSLB 2020-080-6 |                       | 8                      |                   |                          |                       | 50               | 6                       | 5,200                    | 8.21                                | 8.45  | 8.70            | 8.97            | 9.58            |
| HSLB 2020-100   |                       | 10                     |                   |                          |                       | 45               | 4                       | 3,460                    | 10.28                               | 10.58 | 10.90           | 11.25           | 12.02           |
| HSLB 2020-100-6 |                       | 10                     |                   |                          |                       | 50               | 6                       | 5,200                    | 10.28                               | 10.58 | 10.90           | 11.25           | 12.02           |
| HSLB 2020-120   |                       | 12                     |                   |                          |                       | 45               | 4                       | 3,460                    | 12.34                               | 12.71 | 13.10           | 13.53           | 14.47           |
| HSLB 2020-120-6 |                       | 12                     |                   |                          |                       | 50               | 6                       | 5,200                    | 12.34                               | 12.71 | 13.10           | 13.53           | 14.47           |
| HSLB 2020-130   |                       | 13                     |                   |                          |                       | 45               | 4                       | 3,460                    | 13.37                               | 13.77 | 14.20           | 14.67           | 15.69           |
| HSLB 2020-140   |                       | 14                     |                   |                          |                       | 50               | 4                       | 3,460                    | 14.40                               | 14.84 | 15.31           | 15.80           | 16.92           |
| HSLB 2020-160   |                       | 16                     |                   |                          |                       | 50               | 4                       | 3,460                    | 16.46                               | 16.97 | 17.51           | 18.08           | 19.36           |
| HSLB 2020-160-6 |                       | 16                     |                   |                          |                       | 60               | 6                       | 5,200                    | 16.46                               | 16.97 | 17.51           | 18.08           | 19.36           |
| HSLB 2020-180   |                       | 18                     |                   |                          |                       | 55               | 4                       | 3,460                    | 18.53                               | 19.10 | 19.71           | 20.36           | No Interference |
| HSLB 2020-200   |                       | 20                     |                   |                          |                       | 55               | 4                       | 3,460                    | 20.59                               | 21.23 | 21.91           | 22.64           | No Interference |
| HSLB 2020-200-6 |                       | 20                     |                   |                          |                       | 70               | 6                       | 5,200                    | 20.59                               | 21.23 | 21.91           | 22.64           | 24.26           |
| HSLB 2020-220   |                       | 22                     |                   |                          |                       | 60               | 4                       | 4,740                    | 22.65                               | 23.36 | 24.11           | 24.91           | No Interference |
| HSLB 2020-250   |                       | 25                     |                   |                          |                       | 65               | 4                       | 4,830                    | 25.75                               | 26.55 | 27.41           | 28.33           | No Interference |
| HSLB 2020-250-6 |                       | 25                     |                   |                          |                       | 80               | 6                       | 6,840                    | 25.75                               | 26.55 | 27.41           | 28.33           | 30.38           |
| HSLB 2020-270   |                       | 27                     |                   |                          |                       | 65               | 4                       | 4,830                    | 27.81                               | 28.68 | 29.61           | No Interference | No Interference |
| HSLB 2020-300   |                       | 30                     |                   |                          |                       | 70               | 4                       | 5,470                    | 30.90                               | 31.88 | 32.91           | No Interference | No Interference |
| HSLB 2020-300-6 |                       | 30                     |                   |                          |                       | 80               | 6                       | 7,750                    | 30.90                               | 31.88 | 32.91           | 34.02           | 36.50           |
| HSLB 2020-320   |                       | 32                     |                   |                          |                       | 70               | 4                       | 5,470                    | 32.97                               | 34.01 | 35.11           | No Interference | No Interference |
| HSLB 2020-350   |                       | 35                     |                   |                          |                       | 80               | 4                       | 7,480                    | 36.06                               | 37.20 | 38.42           | No Interference | No Interference |
| HSLB 2020-350-6 |                       | 35                     |                   |                          |                       | 80               | 6                       | 10,120                   | 36.06                               | 37.20 | 38.42           | 39.72           | No Interference |
| HSLB 2020-400   |                       | 40                     |                   |                          |                       | 80               | 4                       | 7,480                    | 41.22                               | 42.52 | No Interference | No Interference | No Interference |
| HSLB 2020-400-6 | 40                    | 90                     | 6                 | 10,120                   | 41.22                 | 42.52            | 43.92                   | 45.41                    | No Interference                     |       |                 |                 |                 |
| HSLB 2025-060   | R1.25                 | 6                      | 2                 | 2.45                     | 16°                   | 45               | 4                       | 3,740                    | 6.20                                | 6.36  | 6.53            | 6.72            | 7.14            |
| HSLB 2025-080   |                       | 8                      |                   |                          |                       | 45               | 4                       | 3,760                    | 8.26                                | 8.49  | 8.74            | 9.00            | 9.59            |
| HSLB 2025-100   |                       | 10                     |                   |                          |                       | 45               | 4                       | 3,920                    | 10.32                               | 10.62 | 10.94           | 11.28           | 12.03           |
| HSLB 2025-150   |                       | 15                     |                   |                          |                       | 50               | 4                       | 4,650                    | 15.48                               | 15.94 | 16.44           | 16.97           | No Interference |
| HSLB 2025-200   |                       | 20                     |                   |                          |                       | 55               | 4                       | 5,470                    | 20.64                               | 21.27 | 21.94           | 22.66           | No Interference |
| HSLB 2025-250   |                       | 25                     |                   |                          |                       | 65               | 4                       | 5,840                    | 25.79                               | 26.59 | 27.44           | No Interference | No Interference |
| HSLB 2025-300   |                       | 30                     |                   |                          |                       | 70               | 4                       | 5,840                    | 30.95                               | 31.92 | No Interference | No Interference | No Interference |
| HSLB 2025-350   |                       | 35                     |                   |                          |                       | 70               | 4                       | 6,750                    | 36.11                               | 37.24 | No Interference | No Interference | No Interference |

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φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square Long Neck Square

Radius

Radius Long Neck Radius Taper Neck Radius

Ball / Long Shank Ball

Ball Long Neck Ball Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|-----------------|-----------------------|------------------------|-------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|                 |                       |                        |                   |                          |                           |                  |                         |                          | 30°                                 | 1°              | 1°30'           | 2°              | 3°              |
| HSLB 2030-060   | R1.5                  | 6                      | 2.4               | 2.95                     | 16°                       | 60               | 6                       | 3,460                    | 6.19                                | 6.34            | 6.51            | 6.68            | 7.08            |
| HSLB 2030-060-3 |                       | 6                      |                   |                          | —                         | 60               | 3                       | 3,190                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2030-060-4 |                       | 6                      |                   |                          | 60                        | 4                | 3,190                   | 6.19                     | 6.34                                | 6.51            | 6.68            | 7.08            |                 |
| HSLB 2030-080   |                       | 8                      |                   |                          | 60                        | 6                | 3,460                   | 8.25                     | 8.47                                | 8.71            | 8.96            | 9.53            |                 |
| HSLB 2030-100   |                       | 10                     |                   |                          | 60                        | 6                | 4,020                   | 10.31                    | 10.60                               | 10.91           | 11.24           | 11.98           |                 |
| HSLB 2030-120   |                       | 12                     |                   |                          | 60                        | 6                | 4,190                   | 12.38                    | 12.73                               | 13.11           | 13.52           | 14.42           |                 |
| HSLB 2030-140   |                       | 14                     |                   |                          | 60                        | 6                | 4,650                   | 14.44                    | 14.86                               | 15.31           | 15.79           | 16.87           |                 |
| HSLB 2030-150   |                       | 15                     |                   |                          | 60                        | 6                | 4,560                   | 15.47                    | 15.93                               | 16.41           | 16.93           | 18.09           |                 |
| HSLB 2030-160   |                       | 16                     |                   |                          | 60                        | 6                | 4,650                   | 16.50                    | 16.99                               | 17.51           | 18.07           | 19.32           |                 |
| HSLB 2030-180   |                       | 18                     |                   |                          | 60                        | 6                | 4,650                   | 18.56                    | 19.12                               | 19.71           | 20.35           | 21.77           |                 |
| HSLB 2030-200   |                       | 20                     |                   |                          | 70                        | 6                | 4,470                   | 20.63                    | 21.25                               | 21.91           | 22.63           | 24.21           |                 |
| HSLB 2030-220   |                       | 22                     |                   |                          | 70                        | 6                | 4,470                   | 22.69                    | 23.38                               | 24.12           | 24.90           | 26.66           |                 |
| HSLB 2030-250   |                       | 25                     |                   |                          | 70                        | 6                | 4,470                   | 25.78                    | 26.57                               | 27.42           | 28.32           | 30.33           |                 |
| HSLB 2030-270   |                       | 27                     |                   |                          | 70                        | 6                | 4,470                   | 27.85                    | 28.70                               | 29.62           | 30.60           | No Interference |                 |
| HSLB 2030-300   |                       | 30                     |                   |                          | 70                        | 6                | 5,100                   | 30.94                    | 31.90                               | 32.92           | 34.01           | No Interference |                 |
| HSLB 2030-320   |                       | 32                     |                   |                          | 80                        | 6                | 6,470                   | 33.00                    | 34.03                               | 35.12           | 36.29           | No Interference |                 |
| HSLB 2030-350   | 35                    | 80                     | 6                 | 6,470                    | 36.10                     | 37.22            | 38.42                   | 39.71                    | No Interference                     |                 |                 |                 |                 |
| HSLB 2030-400   | 40                    | 80                     | 6                 | 8,020                    | 41.25                     | 42.55            | 43.92                   | No Interference          | No Interference                     |                 |                 |                 |                 |
| HSLB 2035-100   | R1.75                 | 10                     | 2.8               | 3.45                     | 16°                       | 60               | 6                       | 5,100                    | 10.31                               | 10.59           | 10.88           | 11.21           | 11.92           |
| HSLB 2035-150   |                       | 15                     |                   |                          |                           | 60               | 6                       | 5,100                    | 15.46                               | 15.91           | 16.39           | 16.90           | 18.04           |
| HSLB 2035-200   |                       | 20                     |                   |                          |                           | 65               | 6                       | 5,470                    | 20.62                               | 21.23           | 21.89           | 22.59           | 24.16           |
| HSLB 2035-250   |                       | 25                     |                   |                          |                           | 70               | 6                       | 5,470                    | 25.78                               | 26.56           | 27.39           | 28.29           | No Interference |
| HSLB 2035-300   |                       | 30                     |                   |                          |                           | 70               | 6                       | 5,840                    | 30.93                               | 31.88           | 32.89           | 33.98           | No Interference |
| HSLB 2035-400   |                       | 40                     |                   |                          |                           | 90               | 6                       | 7,750                    | 41.25                               | 42.53           | 43.90           | No Interference | No Interference |
| HSLB 2035-450   |                       | 45                     |                   |                          |                           | 90               | 6                       | 8,480                    | 46.40                               | 47.85           | 49.40           | No Interference | No Interference |
| HSLB 2040-080   | R2                    | 8                      | 3.2               | 3.95                     | 16°                       | 70               | 6                       | 3,560                    | 8.23                                | 8.44            | 8.66            | 8.89            | 9.42            |
| HSLB 2040-080-4 |                       | 8                      |                   |                          | —                         | 70               | 4                       | 3,340                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2040-100   |                       | 10                     |                   |                          | 70                        | 6                | 3,560                   | 10.30                    | 10.57                               | 10.86           | 11.17           | 11.87           |                 |
| HSLB 2040-120   |                       | 12                     |                   |                          | 70                        | 6                | 4,650                   | 12.36                    | 12.70                               | 13.06           | 13.45           | 14.31           |                 |
| HSLB 2040-140   |                       | 14                     |                   |                          | 70                        | 6                | 4,650                   | 14.42                    | 14.83                               | 15.26           | 15.73           | 16.76           |                 |
| HSLB 2040-150   |                       | 15                     |                   |                          | 70                        | 6                | 4,650                   | 15.45                    | 15.89                               | 16.36           | 16.86           | 17.99           |                 |
| HSLB 2040-160   |                       | 16                     |                   |                          | 70                        | 6                | 4,650                   | 16.49                    | 16.96                               | 17.46           | 18.00           | 19.21           |                 |
| HSLB 2040-180   |                       | 18                     |                   |                          | 70                        | 6                | 4,650                   | 18.55                    | 19.09                               | 19.66           | 20.28           | No Interference |                 |
| HSLB 2040-200   |                       | 20                     |                   |                          | 70                        | 6                | 4,650                   | 20.61                    | 21.22                               | 21.86           | 22.56           | No Interference |                 |
| HSLB 2040-220   |                       | 22                     |                   |                          | 70                        | 6                | 4,650                   | 22.67                    | 23.35                               | 24.07           | 24.84           | No Interference |                 |
| HSLB 2040-250   |                       | 25                     |                   |                          | 70                        | 6                | 4,650                   | 25.77                    | 26.54                               | 27.37           | 28.25           | No Interference |                 |
| HSLB 2040-270   |                       | 27                     |                   |                          | 70                        | 6                | 4,650                   | 27.83                    | 28.67                               | 29.57           | 30.53           | No Interference |                 |
| HSLB 2040-300   |                       | 30                     |                   |                          | 70                        | 6                | 4,650                   | 30.93                    | 31.87                               | 32.87           | No Interference | No Interference |                 |
| HSLB 2040-320   |                       | 32                     |                   |                          | 80                        | 6                | 5,380                   | 32.99                    | 34.00                               | 35.07           | No Interference | No Interference |                 |
| HSLB 2040-350   |                       | 35                     |                   |                          | 80                        | 6                | 5,380                   | 36.08                    | 37.19                               | 38.37           | No Interference | No Interference |                 |
| HSLB 2040-400   |                       | 40                     |                   |                          | 90                        | 6                | 6,020                   | 41.24                    | 42.51                               | No Interference | No Interference | No Interference |                 |
| HSLB 2040-450   | 45                    | 90                     | 6                 | 7,750                    | 46.40                     | 47.84            | No Interference         | No Interference          | No Interference                     |                 |                 |                 |                 |
| HSLB 2040-500   | 50                    | 100                    | 6                 | 8,300                    | 51.55                     | 53.16            | No Interference         | No Interference          | No Interference                     |                 |                 |                 |                 |
| HSLB 2040-600   | 60                    | 120                    | 6                 | 8,460                    | 61.87                     | No Interference  | No Interference         | No Interference          | No Interference                     |                 |                 |                 |                 |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



| Model Number  | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bia | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|---------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|               |                       |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°              | 1°30'           | 2°              | 3°              |
| HSLB 2050-100 | R2.5                  | 10                     | 4                 | 4.95                     | 16°                   | 70               | 6                       | 5,470                    | 10.28                               | 10.54           | 10.81           | 11.10           | 11.76           |
| HSLB 2050-150 |                       | 15                     |                   |                          |                       | 70               | 6                       | 7,750                    | 15.44                               | 15.86           | 16.31           | 16.80           | No Interference |
| HSLB 2050-200 |                       | 20                     |                   |                          |                       | 70               | 6                       | 7,750                    | 20.60                               | 21.19           | 21.82           | No Interference | No Interference |
| HSLB 2050-250 |                       | 25                     |                   |                          |                       | 70               | 6                       | 7,750                    | 25.75                               | 26.51           | No Interference | No Interference | No Interference |
| HSLB 2050-300 |                       | 30                     |                   |                          |                       | 80               | 6                       | 8,300                    | 30.91                               | 31.83           | No Interference | No Interference | No Interference |
| HSLB 2050-350 |                       | 35                     |                   |                          |                       | 80               | 6                       | 8,300                    | 36.07                               | No Interference | No Interference | No Interference | No Interference |
| HSLB 2050-400 |                       | 40                     |                   |                          |                       | 90               | 6                       | 10,490                   | 41.22                               | No Interference | No Interference | No Interference | No Interference |
| HSLB 2050-450 |                       | 45                     |                   |                          |                       | 100              | 6                       | 10,940                   | 46.38                               | No Interference | No Interference | No Interference | No Interference |
| HSLB 2050-500 |                       | 50                     |                   |                          |                       | 100              | 6                       | 11,860                   | 51.54                               | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-100 |                       | R3                     |                   |                          |                       | 10               | 4.8                     | 5.95                     | —                                   | 80              | 6               | 5,840           | No Interference |
| HSLB 2060-150 | 15                    |                        | 80                | 6                        | 5,840                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-180 | 18                    |                        | 80                | 6                        | 5,840                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-200 | 20                    |                        | 80                | 6                        | 5,840                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-220 | 22                    |                        | 80                | 6                        | 5,840                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-250 | 25                    |                        | 80                | 6                        | 5,840                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-270 | 27                    |                        | 80                | 6                        | 5,840                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-300 | 30                    |                        | 80                | 6                        | 6,020                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-320 | 32                    |                        | 80                | 6                        | 6,020                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-350 | 35                    |                        | 80                | 6                        | 6,200                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-400 | 40                    |                        | 90                | 6                        | 6,570                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-450 | 45                    |                        | 100               | 6                        | 7,020                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-500 | 50                    |                        | 120               | 6                        | 7,110                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-600 | 60                    |                        | 120               | 6                        | 7,540                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



## Milling Conditions for HSLB / HSLB-S

| WORK MATERIAL |                          |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX (~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                             | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001          | R0.05                    | 0.2                   | 48,000   | 55                 | 0.002                           | 0.002                            | 48,000                                 | 45                 | 0.002                           | 0.002                            | 48,000                                 | 45                 | 0.002                           | 0.002                            | 36,000                                 | 22                 | 0.002                           | 0.002                            |
|               |                          | 0.3                   | 48,000   | 55                 | 0.002                           | 0.002                            | 48,000                                 | 45                 | 0.002                           | 0.002                            | 48,000                                 | 45                 | 0.002                           | 0.002                            | 36,000                                 | 22                 | 0.002                           | 0.002                            |
|               |                          | 0.5                   | 48,000   | 35                 | 0.002                           | 0.002                            | 48,000                                 | 35                 | 0.002                           | 0.002                            | 48,000                                 | 35                 | 0.002                           | 0.002                            | 36,000                                 | 17                 | 0.002                           | 0.002                            |
| 20015         | R0.075                   | 0.3                   | 48,000   | 90                 | 0.004                           | 0.004                            | 48,000                                 | 70                 | 0.004                           | 0.004                            | 48,000                                 | 70                 | 0.004                           | 0.004                            | 36,000                                 | 35                 | 0.004                           | 0.004                            |
|               |                          | 0.5                   | 48,000   | 60                 | 0.004                           | 0.004                            | 48,000                                 | 50                 | 0.004                           | 0.004                            | 48,000                                 | 50                 | 0.004                           | 0.004                            | 36,000                                 | 25                 | 0.004                           | 0.004                            |
|               |                          | 1                     | 48,000   | 60                 | 0.001                           | 0.002                            | 48,000                                 | 20                 | 0.001                           | 0.002                            | 48,000                                 | 20                 | 0.001                           | 0.002                            | 36,000                                 | 10                 | 0.001                           | 0.002                            |
| 2002          | R0.1                     | 0.3                   | 60,000   | 200                | 0.003                           | 0.005                            | 60,000                                 | 200                | 0.002                           | 0.003                            | 60,000                                 | 130                | 0.002                           | 0.003                            | 45,000                                 | 65                 | 0.002                           | 0.003                            |
|               |                          | 0.5                   | 60,000   | 200                | 0.003                           | 0.005                            | 60,000                                 | 200                | 0.002                           | 0.003                            | 60,000                                 | 130                | 0.002                           | 0.003                            | 45,000                                 | 65                 | 0.002                           | 0.003                            |
|               |                          | 0.75                  | 60,000   | 200                | 0.003                           | 0.005                            | 60,000                                 | 200                | 0.002                           | 0.003                            | 60,000                                 | 130                | 0.002                           | 0.003                            | 45,000                                 | 65                 | 0.002                           | 0.003                            |
|               |                          | 1                     | 60,000   | 200                | 0.003                           | 0.005                            | 60,000                                 | 200                | 0.002                           | 0.003                            | 60,000                                 | 130                | 0.002                           | 0.003                            | 45,000                                 | 65                 | 0.002                           | 0.003                            |
|               |                          | 1.25                  | 60,000   | 160                | 0.002                           | 0.004                            | 54,000                                 | 140                | 0.001                           | 0.002                            | 54,000                                 | 95                 | 0.001                           | 0.002                            | 40,500                                 | 45                 | 0.001                           | 0.002                            |
|               |                          | 1.5                   | 60,000   | 130                | 0.002                           | 0.003                            | 48,000                                 | 80                 | 0.001                           | 0.002                            | 48,000                                 | 65                 | 0.001                           | 0.002                            | 36,000                                 | 30                 | 0.001                           | 0.002                            |
|               |                          | 1.75                  | 60,000   | 110                | 0.001                           | 0.002                            | 48,000                                 | 60                 | 0.001                           | 0.001                            | 48,000                                 | 50                 | 0.001                           | 0.001                            | 36,000                                 | 25                 | 0.001                           | 0.001                            |
|               |                          | 2                     | 60,000   | 90                 | 0.001                           | 0.002                            | 48,000                                 | 50                 | 0.001                           | 0.001                            | 48,000                                 | 40                 | 0.001                           | 0.001                            | 36,000                                 | 20                 | 0.001                           | 0.001                            |
|               |                          | 2.25                  | 53,000   | 70                 | 0.001                           | 0.001                            | 44,200                                 | 40                 | 0.001                           | 0.001                            | 44,200                                 | 30                 | 0.001                           | 0.001                            | 33,180                                 | 15                 | 0.001                           | 0.001                            |
|               |                          | 2.5                   | 46,850   | 60                 | 0.001                           | 0.001                            | 40,450                                 | 30                 | 0.001                           | 0.001                            | 40,450                                 | 20                 | 0.001                           | 0.001                            | 30,350                                 | 10                 | 0.001                           | 0.001                            |
| 3             | 33,750                   | 30                    | 0.001  | 0.001              | 33,600                          | 20                               | 0.001                                  | 0.001              | 33,600                          | 15                               | 0.001                                  | 0.001              | 25,200                          | 7                                | 0.001                                  | 0.001              |                                 |                                  |
| 2003          | R0.15                    | 0.5                   | 60,000   | 350                | 0.006                           | 0.008                            | 45,000                                 | 310                | 0.004                           | 0.007                            | 43,500                                 | 180                | 0.003                           | 0.005                            | 32,500                                 | 90                 | 0.003                           | 0.005                            |
|               |                          | 0.6                   | 60,000   | 350                | 0.006                           | 0.008                            | 45,000                                 | 310                | 0.004                           | 0.007                            | 43,500                                 | 180                | 0.003                           | 0.005                            | 32,500                                 | 90                 | 0.003                           | 0.005                            |
|               |                          | 0.75                  | 60,000   | 350                | 0.006                           | 0.008                            | 45,000                                 | 310                | 0.004                           | 0.007                            | 43,500                                 | 180                | 0.003                           | 0.005                            | 32,500                                 | 90                 | 0.003                           | 0.005                            |
|               |                          | 1                     | 60,000   | 350                | 0.006                           | 0.008                            | 45,000                                 | 310                | 0.004                           | 0.007                            | 43,500                                 | 180                | 0.003                           | 0.005                            | 32,500                                 | 90                 | 0.003                           | 0.005                            |
|               |                          | 1.25                  | 60,000   | 350                | 0.006                           | 0.008                            | 45,000                                 | 310                | 0.004                           | 0.007                            | 43,500                                 | 180                | 0.003                           | 0.005                            | 32,500                                 | 90                 | 0.003                           | 0.005                            |
|               |                          | 1.5                   | 60,000   | 350                | 0.006                           | 0.008                            | 45,000                                 | 310                | 0.004                           | 0.007                            | 43,500                                 | 180                | 0.003                           | 0.005                            | 32,500                                 | 90                 | 0.003                           | 0.005                            |
|               |                          | 1.75                  | 60,000   | 280                | 0.005                           | 0.007                            | 45,000                                 | 250                | 0.003                           | 0.006                            | 43,500                                 | 145                | 0.002                           | 0.004                            | 32,500                                 | 70                 | 0.002                           | 0.004                            |
|               |                          | 2                     | 60,000   | 210                | 0.004                           | 0.007                            | 45,000                                 | 190                | 0.003                           | 0.005                            | 43,500                                 | 110                | 0.002                           | 0.004                            | 32,500                                 | 55                 | 0.002                           | 0.004                            |
|               |                          | 2.25                  | 55,600   | 190                | 0.003                           | 0.006                            | 41,500                                 | 160                | 0.002                           | 0.004                            | 40,000                                 | 95                 | 0.001                           | 0.003                            | 30,000                                 | 45                 | 0.001                           | 0.003                            |
|               |                          | 2.5                   | 51,250   | 175                | 0.003                           | 0.005                            | 38,500                                 | 135                | 0.002                           | 0.004                            | 37,750                                 | 85                 | 0.001                           | 0.003                            | 28,300                                 | 40                 | 0.001                           | 0.003                            |
| 3             | 42,500                   | 140                   | 0.002  | 0.004              | 32,000                          | 80                               | 0.002                                  | 0.004              | 32,000                          | 65                               | 0.001                                  | 0.002              | 24,000                          | 30                               | 0.001                                  | 0.002              |                                 |                                  |
| 4             | 23,900                   | 45                    | 0.001  | 0.001              | 22,550                          | 30                               | 0.001                                  | 0.001              | 22,300                          | 20                               | 0.001                                  | 0.001              | 16,720                          | 10                               | 0.001                                  | 0.001              |                                 |                                  |
| 5             | 21,000                   | 30                    | 0.001  | 0.001              | 20,000                          | 20                               | 0.001                                  | 0.001              | 19,500                          | 10                               | 0.001                                  | 0.001              | 14,600                          | 5                                | 0.001                                  | 0.001              |                                 |                                  |
| 2004          | R0.2                     | 0.5                   | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                                 | 420                | 0.007                           | 0.012                            | 35,000                                 | 240                | 0.005                           | 0.008                            | 26,250                                 | 120                | 0.005                           | 0.008                            |
|               |                          | 0.75                  | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                                 | 420                | 0.007                           | 0.012                            | 35,000                                 | 240                | 0.005                           | 0.008                            | 26,250                                 | 120                | 0.005                           | 0.008                            |
|               |                          | 1                     | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                                 | 420                | 0.007                           | 0.012                            | 35,000                                 | 240                | 0.005                           | 0.008                            | 26,250                                 | 120                | 0.005                           | 0.008                            |
|               |                          | 1.25                  | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                                 | 420                | 0.007                           | 0.012                            | 35,000                                 | 240                | 0.005                           | 0.008                            | 26,250                                 | 120                | 0.005                           | 0.008                            |
|               |                          | 1.5                   | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                                 | 420                | 0.007                           | 0.012                            | 35,000                                 | 240                | 0.005                           | 0.008                            | 26,250                                 | 120                | 0.005                           | 0.008                            |
|               |                          | 1.75                  | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                                 | 420                | 0.007                           | 0.012                            | 35,000                                 | 240                | 0.005                           | 0.008                            | 26,250                                 | 120                | 0.005                           | 0.008                            |
|               |                          | 2                     | 50,000   | 500                | 0.01                            | 0.02                             | 37,500                                 | 420                | 0.007                           | 0.012                            | 35,000                                 | 240                | 0.005                           | 0.008                            | 26,250                                 | 120                | 0.005                           | 0.008                            |
|               |                          | 2.25                  | 47,500   | 430                | 0.008                           | 0.016                            | 36,000                                 | 360                | 0.006                           | 0.01                             | 33,750                                 | 210                | 0.004                           | 0.007                            | 25,270                                 | 100                | 0.004                           | 0.007                            |
|               |                          | 2.5                   | 45,000   | 360                | 0.007                           | 0.012                            | 34,500                                 | 300                | 0.005                           | 0.008                            | 32,500                                 | 190                | 0.004                           | 0.007                            | 24,300                                 | 95                 | 0.004                           | 0.007                            |
|               |                          | 3                     | 40,000   | 250                | 0.005                           | 0.008                            | 31,900                                 | 210                | 0.004                           | 0.008                            | 30,500                                 | 160                | 0.003                           | 0.005                            | 22,800                                 | 80                 | 0.003                           | 0.005                            |
|               |                          | 3.5                   | 36,000   | 210                | 0.004                           | 0.007                            | 28,700                                 | 180                | 0.003                           | 0.006                            | 27,400                                 | 140                | 0.002                           | 0.004                            | 20,550                                 | 70                 | 0.002                           | 0.004                            |
|               |                          | 4                     | 32,000   | 180                | 0.003                           | 0.005                            | 25,500                                 | 150                | 0.002                           | 0.004                            | 24,300                                 | 120                | 0.002                           | 0.004                            | 18,200                                 | 60                 | 0.002                           | 0.004                            |
|               |                          | 4.5                   | 28,500   | 150                | 0.002                           | 0.004                            | 23,500                                 | 125                | 0.002                           | 0.003                            | 22,400                                 | 100                | 0.001                           | 0.003                            | 16,800                                 | 50                 | 0.001                           | 0.003                            |
| 5             | 25,000                   | 120                   | 0.002  | 0.003              | 21,500                          | 100                              | 0.001                                  | 0.002              | 20,500                          | 80                               | 0.001                                  | 0.002              | 15,350                          | 40                               | 0.001                                  | 0.002              |                                 |                                  |
| 6             | 18,000                   | 60                    | 0.001  | 0.002              | 18,000                          | 60                               | 0.001                                  | 0.002              | 17,000                          | 45                               | 0.001                                  | 0.002              | 12,750                          | 20                               | 0.001                                  | 0.002              |                                 |                                  |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for HSLB / HSLB-S

| WORK MATERIAL |                          |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX (~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                             | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2005          | R0.25                    | 1                     | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             | 22,500                                 | 150                | 0.007                           | 0.01                             |
|               |                          | 1.25                  | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             | 22,500                                 | 150                | 0.007                           | 0.01                             |
|               |                          | 1.5                   | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             | 22,500                                 | 150                | 0.007                           | 0.01                             |
|               |                          | 1.75                  | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             | 22,500                                 | 150                | 0.007                           | 0.01                             |
|               |                          | 2                     | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             | 22,500                                 | 150                | 0.007                           | 0.01                             |
|               |                          | 2.25                  | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             | 22,500                                 | 150                | 0.007                           | 0.01                             |
|               |                          | 2.5                   | 44,000   | 650                | 0.015                           | 0.04                             | 33,000                                 | 530                | 0.01                            | 0.02                             | 30,000                                 | 300                | 0.007                           | 0.01                             | 22,500                                 | 150                | 0.007                           | 0.01                             |
|               |                          | 3                     | 40,000   | 500                | 0.01                            | 0.02                             | 31,000                                 | 400                | 0.007                           | 0.01                             | 28,550                                 | 230                | 0.005                           | 0.008                            | 21,400                                 | 115                | 0.005                           | 0.008                            |
|               |                          | 3.5                   | 36,350   | 340                | 0.007                           | 0.017                            | 29,000                                 | 270                | 0.005                           | 0.008                            | 27,100                                 | 160                | 0.003                           | 0.006                            | 20,300                                 | 80                 | 0.003                           | 0.006                            |
|               |                          | 4                     | 32,700   | 180                | 0.005                           | 0.015                            | 27,150                                 | 150                | 0.003                           | 0.008                            | 25,650                                 | 100                | 0.002                           | 0.005                            | 19,900                                 | 50                 | 0.002                           | 0.005                            |
|               |                          | 4.5                   | 29,900   | 150                | 0.004                           | 0.01                             | 25,700                                 | 130                | 0.002                           | 0.007                            | 24,500                                 | 85                 | 0.002                           | 0.004                            | 18,350                                 | 43                 | 0.002                           | 0.004                            |
|               |                          | 5                     | 27,000   | 135                | 0.003                           | 0.008                            | 24,200                                 | 110                | 0.002                           | 0.005                            | 23,500                                 | 75                 | 0.002                           | 0.004                            | 17,600                                 | 35                 | 0.002                           | 0.004                            |
|               |                          | 5.5                   | 24,150   | 110                | 0.002                           | 0.006                            | 22,750                                 | 90                 | 0.001                           | 0.004                            | 22,400                                 | 60                 | 0.001                           | 0.003                            | 16,800                                 | 30                 | 0.001                           | 0.003                            |
|               |                          | 6                     | 21,350   | 90                 | 0.002                           | 0.005                            | 21,300                                 | 75                 | 0.001                           | 0.003                            | 21,300                                 | 50                 | 0.001                           | 0.002                            | 16,000                                 | 25                 | 0.001                           | 0.002                            |
| 7             | 18,600                   | 75                    | 0.001  | 0.004              | 18,600                          | 55                               | 0.001                                  | 0.002              | 18,600                          | 35                               | 0.001                                  | 0.002              | 13,950                          | 17                               | 0.001                                  | 0.002              |                                 |                                  |
| 8             | 15,900                   | 60                    | 0.001  | 0.003              | 15,900                          | 40                               | 0.001                                  | 0.002              | 15,900                          | 25                               | 0.001                                  | 0.002              | 11,950                          | 12                               | 0.001                                  | 0.002              |                                 |                                  |
| 9             | 15,400                   | 55                    | 0.001  | 0.002              | 14,750                          | 30                               | 0.001                                  | 0.001              | 14,750                          | 20                               | 0.001                                  | 0.001              | 11,050                          | 10                               | 0.001                                  | 0.001              |                                 |                                  |
| 10            | 14,900                   | 50                    | 0.001  | 0.002              | 13,600                          | 20                               | 0.001                                  | 0.001              | 13,600                          | 15                               | 0.001                                  | 0.001              | 10,200                          | 7                                | 0.001                                  | 0.001              |                                 |                                  |
| 2006          | R0.3                     | 1                     | 40,000   | 1,400              | 0.045                           | 0.15                             | 30,000                                 | 1,500              | 0.03                            | 0.13                             | 26,500                                 | 1,000              | 0.015                           | 0.09                             | 20,000                                 | 500                | 0.015                           | 0.09                             |
|               |                          | 1.25                  | 40,000   | 1,250              | 0.035                           | 0.14                             | 30,000                                 | 1,350              | 0.025                           | 0.11                             | 26,500                                 | 900                | 0.01                            | 0.08                             | 20,000                                 | 450                | 0.01                            | 0.08                             |
|               |                          | 1.5                   | 40,000   | 1,100              | 0.03                            | 0.13                             | 30,000                                 | 1,200              | 0.02                            | 0.1                              | 26,500                                 | 800                | 0.01                            | 0.075                            | 20,000                                 | 400                | 0.01                            | 0.075                            |
|               |                          | 1.75                  | 40,000   | 1,100              | 0.03                            | 0.13                             | 30,000                                 | 1,200              | 0.02                            | 0.1                              | 26,500                                 | 800                | 0.01                            | 0.075                            | 20,000                                 | 400                | 0.01                            | 0.075                            |
|               |                          | 2                     | 40,000   | 1,100              | 0.03                            | 0.13                             | 30,000                                 | 1,200              | 0.02                            | 0.1                              | 26,500                                 | 800                | 0.01                            | 0.075                            | 20,000                                 | 400                | 0.01                            | 0.075                            |
|               |                          | 2.25                  | 40,000   | 950                | 0.025                           | 0.1                              | 30,000                                 | 1,000              | 0.015                           | 0.09                             | 26,500                                 | 660                | 0.008                           | 0.065                            | 20,000                                 | 330                | 0.008                           | 0.07                             |
|               |                          | 2.5                   | 40,000   | 800                | 0.02                            | 0.1                              | 30,000                                 | 800                | 0.015                           | 0.09                             | 26,500                                 | 520                | 0.008                           | 0.065                            | 20,000                                 | 260                | 0.008                           | 0.065                            |
|               |                          | 3                     | 40,000   | 800                | 0.02                            | 0.1                              | 30,000                                 | 800                | 0.015                           | 0.09                             | 26,500                                 | 520                | 0.008                           | 0.065                            | 20,000                                 | 260                | 0.008                           | 0.065                            |
|               |                          | 3.5                   | 40,000   | 500                | 0.015                           | 0.09                             | 30,000                                 | 500                | 0.01                            | 0.075                            | 26,500                                 | 340                | 0.006                           | 0.05                             | 20,000                                 | 170                | 0.006                           | 0.05                             |
|               |                          | 4                     | 40,000   | 500                | 0.015                           | 0.09                             | 30,000                                 | 500                | 0.01                            | 0.075                            | 26,500                                 | 340                | 0.006                           | 0.05                             | 20,000                                 | 170                | 0.006                           | 0.05                             |
|               |                          | 4.5                   | 32,000   | 400                | 0.01                            | 0.075                            | 25,000                                 | 390                | 0.007                           | 0.05                             | 23,000                                 | 260                | 0.005                           | 0.04                             | 18,000                                 | 130                | 0.005                           | 0.04                             |
|               |                          | 5                     | 32,000   | 400                | 0.01                            | 0.075                            | 25,000                                 | 390                | 0.007                           | 0.05                             | 23,000                                 | 260                | 0.005                           | 0.04                             | 18,000                                 | 130                | 0.005                           | 0.04                             |
|               |                          | 5.5                   | 28,000   | 350                | 0.008                           | 0.065                            | 23,000                                 | 350                | 0.006                           | 0.05                             | 21,000                                 | 230                | 0.004                           | 0.04                             | 15,750                                 | 115                | 0.004                           | 0.04                             |
|               |                          | 6                     | 24,000   | 300                | 0.007                           | 0.06                             | 21,000                                 | 320                | 0.005                           | 0.04                             | 19,500                                 | 210                | 0.004                           | 0.03                             | 15,000                                 | 105                | 0.004                           | 0.03                             |
| 6.5           | 22,000                   | 270                   | 0.006  | 0.06               | 19,500                          | 300                              | 0.004                                  | 0.04               | 18,500                          | 190                              | 0.003                                  | 0.03               | 13,900                          | 95                               | 0.003                                  | 0.03               |                                 |                                  |
| 7             | 20,000                   | 250                   | 0.006  | 0.05               | 18,500                          | 280                              | 0.004                                  | 0.03               | 17,500                          | 180                              | 0.003                                  | 0.02               | 13,100                          | 90                               | 0.003                                  | 0.02               |                                 |                                  |
| 8             | 16,000                   | 200                   | 0.005  | 0.05               | 16,000                          | 240                              | 0.003                                  | 0.02               | 16,000                          | 160                              | 0.003                                  | 0.02               | 12,000                          | 80                               | 0.003                                  | 0.02               |                                 |                                  |
| 9             | 15,450                   | 185                   | 0.004  | 0.035              | 15,450                          | 200                              | 0.002                                  | 0.017              | 15,450                          | 135                              | 0.002                                  | 0.017              | 11,580                          | 65                               | 0.002                                  | 0.017              |                                 |                                  |
| 10            | 14,900                   | 175                   | 0.003  | 0.02               | 14,900                          | 175                              | 0.002                                  | 0.015              | 14,900                          | 115                              | 0.002                                  | 0.015              | 11,100                          | 55                               | 0.002                                  | 0.015              |                                 |                                  |
| 12            | 13,800                   | 150                   | 0.002  | 0.015              | 13,800                          | 110                              | 0.001                                  | 0.01               | 13,800                          | 70                               | 0.001                                  | 0.01               | 10,350                          | 35                               | 0.001                                  | 0.01               |                                 |                                  |
| 2007          | R0.35                    | 2                     | 37,000   | 1,350              | 0.045                           | 0.17                             | 28,500                                 | 1,400              | 0.03                            | 0.135                            | 25,000                                 | 900                | 0.015                           | 0.1                              | 18,750                                 | 450                | 0.015                           | 0.1                              |
|               |                          | 4                     | 31,250   | 920                | 0.035                           | 0.15                             | 25,750                                 | 975                | 0.025                           | 0.12                             | 23,750                                 | 650                | 0.012                           | 0.09                             | 17,800                                 | 325                | 0.012                           | 0.09                             |
|               |                          | 6                     | 25,500   | 500                | 0.025                           | 0.13                             | 23,000                                 | 550                | 0.02                            | 0.11                             | 22,500                                 | 400                | 0.01                            | 0.08                             | 16,850                                 | 200                | 0.01                            | 0.08                             |
|               |                          | 8                     | 19,000   | 270                | 0.007                           | 0.06                             | 17,000                                 | 320                | 0.005                           | 0.04                             | 16,500                                 | 220                | 0.004                           | 0.025                            | 12,350                                 | 110                | 0.004                           | 0.025                            |

## Milling Conditions for HSLB / HSLB-S

| WORK MATERIAL |                          |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX (~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                             | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2008          | R0.4                     | 2                     | 35,000   | 1,600              | 0.06                            | 0.21                             | 27,000                                 | 1,600              | 0.04                            | 0.17                             | 23,500                                 | 1,000              | 0.02                            | 0.12                             | 17,500                                 | 500                | 0.02                            | 0.12                             |
|               |                          | 3                     | 35,000   | 1,400              | 0.05                            | 0.19                             | 27,000                                 | 1,400              | 0.03                            | 0.15                             | 23,500                                 | 900                | 0.015                           | 0.1                              | 17,500                                 | 450                | 0.015                           | 0.1                              |
|               |                          | 4                     | 35,000   | 1,200              | 0.04                            | 0.17                             | 27,000                                 | 1,200              | 0.025                           | 0.135                            | 23,500                                 | 600                | 0.012                           | 0.095                            | 17,500                                 | 300                | 0.012                           | 0.095                            |
|               |                          | 5                     | 31,500   | 900                | 0.03                            | 0.15                             | 25,000                                 | 900                | 0.02                            | 0.12                             | 22,000                                 | 500                | 0.01                            | 0.085                            | 16,500                                 | 250                | 0.01                            | 0.085                            |
|               |                          | 6                     | 28,000   | 600                | 0.02                            | 0.12                             | 23,000                                 | 600                | 0.012                           | 0.095                            | 20,500                                 | 400                | 0.006                           | 0.065                            | 15,500                                 | 200                | 0.006                           | 0.065                            |
|               |                          | 7                     | 23,750   | 460                | 0.016                           | 0.105                            | 20,500                                 | 480                | 0.009                           | 0.08                             | 18,750                                 | 340                | 0.005                           | 0.062                            | 14,000                                 | 170                | 0.005                           | 0.062                            |
|               |                          | 8                     | 19,500   | 330                | 0.012                           | 0.095                            | 18,000                                 | 375                | 0.007                           | 0.07                             | 17,000                                 | 285                | 0.005                           | 0.06                             | 12,750                                 | 140                | 0.005                           | 0.06                             |
|               |                          | 9                     | 17,500   | 290                | 0.011                           | 0.09                             | 16,000                                 | 350                | 0.006                           | 0.06                             | 15,700                                 | 250                | 0.005                           | 0.05                             | 11,800                                 | 125                | 0.005                           | 0.05                             |
|               |                          | 10                    | 15,000   | 260                | 0.01                            | 0.085                            | 14,700                                 | 340                | 0.005                           | 0.06                             | 14,650                                 | 225                | 0.004                           | 0.05                             | 11,000                                 | 110                | 0.004                           | 0.05                             |
|               |                          | 12                    | 14,000   | 220                | 0.005                           | 0.06                             | 13,700                                 | 290                | 0.003                           | 0.04                             | 13,650                                 | 140                | 0.002                           | 0.03                             | 10,250                                 | 70                 | 0.002                           | 0.03                             |
| 16            | 13,300                   | 185                   | 0.003  | 0.02               | 11,100                          | 150                              | 0.001                                  | 0.013              | 11,100                          | 90                               | 0.001                                  | 0.013              | 8,300                           | 45                               | 0.001                                  | 0.013              |                                 |                                  |
| 2009          | R0.45                    | 2                     | 32,500   | 1,650              | 0.1                             | 0.28                             | 25,500                                 | 1,800              | 0.055                           | 0.21                             | 22,000                                 | 1,300              | 0.025                           | 0.14                             | 16,500                                 | 650                | 0.025                           | 0.14                             |
|               |                          | 4                     | 32,500   | 1,650              | 0.08                            | 0.25                             | 25,500                                 | 1,800              | 0.04                            | 0.18                             | 22,000                                 | 1,300              | 0.02                            | 0.13                             | 16,500                                 | 650                | 0.02                            | 0.13                             |
|               |                          | 6                     | 29,000   | 800                | 0.035                           | 0.17                             | 22,000                                 | 800                | 0.02                            | 0.13                             | 20,000                                 | 620                | 0.015                           | 0.11                             | 15,000                                 | 310                | 0.015                           | 0.11                             |
|               |                          | 8                     | 25,500   | 700                | 0.015                           | 0.11                             | 18,500                                 | 500                | 0.01                            | 0.09                             | 18,500                                 | 420                | 0.01                            | 0.09                             | 13,850                                 | 210                | 0.01                            | 0.09                             |
|               |                          | 10                    | 20,000   | 400                | 0.012                           | 0.1                              | 15,700                                 | 400                | 0.008                           | 0.08                             | 15,700                                 | 300                | 0.008                           | 0.08                             | 11,800                                 | 150                | 0.008                           | 0.08                             |
|               |                          | 12                    | 15,000   | 280                | 0.01                            | 0.09                             | 13,300                                 | 300                | 0.006                           | 0.07                             | 13,300                                 | 220                | 0.006                           | 0.07                             | 10,000                                 | 110                | 0.006                           | 0.07                             |
|               |                          | 14                    | 14,000   | 240                | 0.007                           | 0.07                             | 12,000                                 | 250                | 0.004                           | 0.035                            | 12,000                                 | 160                | 0.004                           | 0.035                            | 9,000                                  | 80                 | 0.004                           | 0.035                            |
|               |                          | 16                    | 13,700   | 220                | 0.005                           | 0.05                             | 10,800                                 | 200                | 0.003                           | 0.03                             | 10,800                                 | 130                | 0.003                           | 0.03                             | 8,100                                  | 65                 | 0.003                           | 0.03                             |
| 18            | 13,000                   | 200                   | 0.004  | 0.025              | 9,750                           | 150                              | 0.002                                  | 0.015              | 9,750                           | 100                              | 0.002                                  | 0.015              | 7,300                           | 50                               | 0.002                                  | 0.015              |                                 |                                  |
| 2010          | R0.5                     | 2                     | 30,000   | 1,750              | 0.2                             | 0.4                              | 24,000                                 | 2,000              | 0.1                             | 0.3                              | 21,000                                 | 1,750              | 0.05                            | 0.2                              | 16,000                                 | 875                | 0.05                            | 0.2                              |
|               |                          | 2.5                   | 30,000   | 1,750              | 0.2                             | 0.4                              | 24,000                                 | 2,000              | 0.1                             | 0.3                              | 21,000                                 | 1,750              | 0.05                            | 0.2                              | 16,000                                 | 875                | 0.05                            | 0.2                              |
|               |                          | 3                     | 30,000   | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.05                            | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             | 16,000                                 | 875                | 0.03                            | 0.17                             |
|               |                          | 4                     | 30,000   | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.05                            | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             | 16,000                                 | 875                | 0.03                            | 0.17                             |
|               |                          | 5                     | 30,000   | 1,750              | 0.1                             | 0.3                              | 24,000                                 | 2,000              | 0.05                            | 0.2                              | 21,000                                 | 1,750              | 0.03                            | 0.17                             | 16,000                                 | 875                | 0.03                            | 0.17                             |
|               |                          | 6                     | 30,000   | 1,150              | 0.06                            | 0.23                             | 21,500                                 | 1,250              | 0.03                            | 0.17                             | 19,700                                 | 1,050              | 0.025                           | 0.15                             | 14,500                                 | 525                | 0.025                           | 0.15                             |
|               |                          | 7                     | 24,250   | 800                | 0.04                            | 0.19                             | 20,000                                 | 900                | 0.02                            | 0.14                             | 19,000                                 | 750                | 0.02                            | 0.14                             | 14,250                                 | 375                | 0.02                            | 0.14                             |
|               |                          | 8                     | 24,000   | 800                | 0.025                           | 0.155                            | 18,500                                 | 580                | 0.015                           | 0.12                             | 18,400                                 | 480                | 0.015                           | 0.12                             | 13,800                                 | 240                | 0.015                           | 0.12                             |
|               |                          | 9                     | 23,000   | 700                | 0.021                           | 0.14                             | 16,650                                 | 500                | 0.012                           | 0.1                              | 16,550                                 | 420                | 0.012                           | 0.1                              | 12,400                                 | 210                | 0.012                           | 0.1                              |
|               |                          | 10                    | 22,000   | 600                | 0.018                           | 0.13                             | 14,800                                 | 430                | 0.01                            | 0.09                             | 14,700                                 | 360                | 0.01                            | 0.09                             | 11,100                                 | 180                | 0.01                            | 0.09                             |
|               |                          | 12                    | 14,150   | 320                | 0.015                           | 0.12                             | 13,400                                 | 380                | 0.008                           | 0.08                             | 13,300                                 | 290                | 0.008                           | 0.08                             | 9,950                                  | 145                | 0.008                           | 0.08                             |
|               |                          | 14                    | 13,500   | 280                | 0.012                           | 0.1                              | 12,000                                 | 350                | 0.007                           | 0.08                             | 12,000                                 | 220                | 0.007                           | 0.08                             | 9,000                                  | 110                | 0.007                           | 0.08                             |
|               |                          | 16                    | 12,750   | 240                | 0.008                           | 0.08                             | 10,500                                 | 250                | 0.005                           | 0.045                            | 10,500                                 | 160                | 0.005                           | 0.045                            | 7,850                                  | 80                 | 0.005                           | 0.045                            |
|               |                          | 18                    | 12,350   | 220                | 0.006                           | 0.065                            | 9,750                                  | 200                | 0.004                           | 0.035                            | 9,750                                  | 130                | 0.004                           | 0.035                            | 7,300                                  | 65                 | 0.004                           | 0.035                            |
| 20            | 12,000                   | 200                   | 0.005  | 0.03               | 9,000                           | 150                              | 0.003                                  | 0.02               | 9,000                           | 100                              | 0.003                                  | 0.02               | 6,750                           | 50                               | 0.003                                  | 0.02               |                                 |                                  |
| 22            | 12,000                   | 150                   | 0.003  | 0.02               | 9,000                           | 110                              | 0.002                                  | 0.012              | 9,000                           | 75                               | 0.002                                  | 0.012              | 6,750                           | 35                               | 0.002                                  | 0.012              |                                 |                                  |
| 2012          | R0.6                     | 2.5                   | 30,000   | 2,000              | 0.22                            | 0.46                             | 20,500                                 | 2,000              | 0.11                            | 0.34                             | 17,800                                 | 1,750              | 0.05                            | 0.23                             | 13,350                                 | 875                | 0.05                            | 0.23                             |
|               |                          | 4                     | 30,000   | 2,000              | 0.12                            | 0.36                             | 20,000                                 | 2,000              | 0.06                            | 0.24                             | 17,500                                 | 1,750              | 0.036                           | 0.2                              | 13,100                                 | 875                | 0.036                           | 0.2                              |
|               |                          | 6                     | 30,000   | 2,000              | 0.12                            | 0.36                             | 20,000                                 | 2,000              | 0.06                            | 0.24                             | 17,500                                 | 1,750              | 0.036                           | 0.2                              | 13,100                                 | 875                | 0.036                           | 0.2                              |
|               |                          | 8                     | 20,200   | 800                | 0.05                            | 0.23                             | 16,600                                 | 900                | 0.025                           | 0.17                             | 15,850                                 | 750                | 0.025                           | 0.17                             | 11,900                                 | 375                | 0.025                           | 0.17                             |
|               |                          | 10                    | 15,500   | 480                | 0.03                            | 0.18                             | 15,500                                 | 580                | 0.015                           | 0.13                             | 15,350                                 | 480                | 0.015                           | 0.13                             | 11,500                                 | 240                | 0.015                           | 0.13                             |
|               |                          | 12                    | 12,400   | 360                | 0.02                            | 0.15                             | 12,400                                 | 430                | 0.01                            | 0.095                            | 12,250                                 | 360                | 0.01                            | 0.095                            | 9,200                                  | 180                | 0.01                            | 0.095                            |
|               |                          | 14                    | 11,850   | 320                | 0.018                           | 0.14                             | 11,200                                 | 380                | 0.008                           | 0.085                            | 11,100                                 | 290                | 0.008                           | 0.085                            | 8,300                                  | 145                | 0.008                           | 0.085                            |
|               |                          | 16                    | 11,300   | 280                | 0.014                           | 0.12                             | 10,000                                 | 360                | 0.007                           | 0.08                             | 10,000                                 | 230                | 0.007                           | 0.08                             | 7,500                                  | 115                | 0.007                           | 0.08                             |
|               |                          | 18                    | 10,900   | 260                | 0.011                           | 0.1                              | 9,400                                  | 300                | 0.006                           | 0.07                             | 9,400                                  | 190                | 0.006                           | 0.07                             | 7,050                                  | 95                 | 0.006                           | 0.07                             |
|               |                          | 20                    | 10,500   | 240                | 0.009                           | 0.09                             | 8,800                                  | 250                | 0.006                           | 0.05                             | 8,800                                  | 160                | 0.006                           | 0.05                             | 6,600                                  | 80                 | 0.006                           | 0.05                             |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for HSLB / HSLB-S

| WORK MATERIAL |                          |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX (~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                             | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2014          | R0.7                     | 6                     | 25,200   | 2,000              | 0.13                            | 0.42                             | 17,150                                 | 2,000              | 0.065                           | 0.27                             | 15,000                                 | 1,750              | 0.036                           | 0.23                             | 11,250                                 | 875                | 0.036                           | 0.23                             |
|               |                          | 8                     | 25,200   | 1,300              | 0.08                            | 0.32                             | 15,350                                 | 1,250              | 0.04                            | 0.23                             | 14,050                                 | 1,050              | 0.03                            | 0.2                              | 10,550                                 | 525                | 0.03                            | 0.2                              |
|               |                          | 12                    | 13,500   | 450                | 0.035                           | 0.21                             | 12,500                                 | 460                | 0.025                           | 0.18                             | 12,000                                 | 300                | 0.02                            | 0.16                             | 9,000                                  | 150                | 0.02                            | 0.16                             |
|               |                          | 16                    | 10,000   | 320                | 0.016                           | 0.145                            | 9,050                                  | 390                | 0.01                            | 0.12                             | 8,850                                  | 230                | 0.012                           | 0.12                             | 6,650                                  | 115                | 0.012                           | 0.12                             |
| 2015          | R0.75                    | 3                     | 30,000   | 2,450              | 0.25                            | 0.55                             | 17,000                                 | 2,000              | 0.12                            | 0.4                              | 15,000                                 | 1,750              | 0.06                            | 0.29                             | 11,250                                 | 875                | 0.06                            | 0.29                             |
|               |                          | 4                     | 30,000   | 2,450              | 0.25                            | 0.55                             | 17,000                                 | 2,000              | 0.12                            | 0.4                              | 15,000                                 | 1,750              | 0.06                            | 0.29                             | 11,250                                 | 875                | 0.06                            | 0.29                             |
|               |                          | 6                     | 30,000   | 2,450              | 0.15                            | 0.45                             | 17,000                                 | 2,000              | 0.07                            | 0.31                             | 15,000                                 | 1,750              | 0.04                            | 0.24                             | 11,250                                 | 875                | 0.04                            | 0.24                             |
|               |                          | 8                     | 23,500   | 1,300              | 0.1                             | 0.37                             | 15,000                                 | 1,250              | 0.045                           | 0.25                             | 14,000                                 | 1,050              | 0.03                            | 0.21                             | 10,500                                 | 525                | 0.03                            | 0.21                             |
|               |                          | 10                    | 23,500   | 1,300              | 0.1                             | 0.37                             | 15,000                                 | 1,250              | 0.045                           | 0.25                             | 14,000                                 | 1,050              | 0.03                            | 0.21                             | 10,500                                 | 525                | 0.03                            | 0.21                             |
|               |                          | 12                    | 13,100   | 480                | 0.03                            | 0.21                             | 13,000                                 | 580                | 0.02                            | 0.17                             | 13,000                                 | 480                | 0.02                            | 0.17                             | 9,750                                  | 240                | 0.02                            | 0.17                             |
|               |                          | 14                    | 11,200   | 400                | 0.025                           | 0.19                             | 10,900                                 | 485                | 0.015                           | 0.145                            | 10,900                                 | 385                | 0.015                           | 0.145                            | 8,200                                  | 190                | 0.015                           | 0.145                            |
|               |                          | 16                    | 9,350  | 320                | 0.02                            | 0.17                             | 8,850                                  | 390                | 0.012                           | 0.13                             | 8,800                                  | 290                | 0.012                           | 0.13                             | 6,600                                  | 145                | 0.012                           | 0.13                             |
|               |                          | 18                    | 9,150  | 300                | 0.019                           | 0.165                            | 8,400                                  | 370                | 0.011                           | 0.125                            | 8,400                                  | 255                | 0.011                           | 0.125                            | 6,300                                  | 125                | 0.011                           | 0.125                            |
|               |                          | 20                    | 9,000  | 280                | 0.018                           | 0.16                             | 8,000                                  | 350                | 0.01                            | 0.12                             | 8,000                                  | 220                | 0.01                            | 0.12                             | 6,000                                  | 110                | 0.01                            | 0.12                             |
|               |                          | 22                    | 8,580  | 245                | 0.014                           | 0.13                             | 7,150                                  | 320                | 0.008                           | 0.12                             | 7,150                                  | 165                | 0.008                           | 0.12                             | 5,350                                  | 80                 | 0.008                           | 0.12                             |
|               |                          | 25                    | 8,100  | 210                | 0.01                            | 0.11                             | 6,250                                  | 220                | 0.006                           | 0.09                             | 6,250                                  | 120                | 0.005                           | 0.08                             | 4,700                                  | 60                 | 0.005                           | 0.08                             |
| 2016          | R0.8                     | 4                     | 30,000   | 2,500              | 0.25                            | 0.58                             | 17,500                                 | 2,100              | 0.12                            | 0.4                              | 15,300                                 | 1,800              | 0.06                            | 0.3                              | 11,500                                 | 900                | 0.06                            | 0.3                              |
|               |                          | 8                     | 30,000   | 2,500              | 0.16                            | 0.48                             | 17,500                                 | 2,100              | 0.08                            | 0.32                             | 15,300                                 | 1,800              | 0.05                            | 0.275                            | 11,500                                 | 900                | 0.05                            | 0.275                            |
|               |                          | 12                    | 13,500   | 500                | 0.04                            | 0.245                            | 13,500                                 | 600                | 0.024                           | 0.19                             | 13,400                                 | 490                | 0.024                           | 0.19                             | 10,050                                 | 245                | 0.024                           | 0.19                             |
|               |                          | 16                    | 10,800   | 375                | 0.03                            | 0.21                             | 10,800                                 | 450                | 0.016                           | 0.15                             | 10,700                                 | 370                | 0.016                           | 0.15                             | 8,000                                  | 185                | 0.016                           | 0.15                             |
|               |                          | 20                    | 10,300   | 330                | 0.025                           | 0.19                             | 9,750                                  | 400                | 0.013                           | 0.13                             | 9,650                                  | 230                | 0.013                           | 0.13                             | 8,000                                  | 115                | 0.013                           | 0.13                             |
| 2018          | R0.9                     | 4                     | 30,000   | 2,700              | 0.28                            | 0.65                             | 15,000                                 | 2,000              | 0.14                            | 0.48                             | 13,000                                 | 1,750              | 0.07                            | 0.34                             | 9,750                                  | 875                | 0.07                            | 0.34                             |
|               |                          | 6                     | 30,000   | 2,700              | 0.18                            | 0.54                             | 15,000                                 | 2,000              | 0.07                            | 0.34                             | 13,000                                 | 1,750              | 0.04                            | 0.26                             | 9,750                                  | 875                | 0.04                            | 0.26                             |
|               |                          | 8                     | 30,000   | 2,700              | 0.18                            | 0.54                             | 15,000                                 | 2,000              | 0.07                            | 0.34                             | 13,000                                 | 1,750              | 0.04                            | 0.26                             | 9,750                                  | 875                | 0.04                            | 0.26                             |
|               |                          | 10                    | 25,750   | 2,000              | 0.14                            | 0.48                             | 14,400                                 | 1,650              | 0.06                            | 0.32                             | 12,900                                 | 1,425              | 0.035                           | 0.24                             | 9,700                                  | 713                | 0.035                           | 0.24                             |
|               |                          | 12                    | 21,500   | 1,350              | 0.1                             | 0.41                             | 13,800                                 | 1,350              | 0.05                            | 0.29                             | 12,800                                 | 1,100              | 0.03                            | 0.23                             | 9,600                                  | 550                | 0.03                            | 0.23                             |
|               |                          | 16                    | 15,550   | 860                | 0.065                           | 0.33                             | 11,700                                 | 900                | 0.03                            | 0.22                             | 11,150                                 | 730                | 0.02                            | 0.18                             | 8,400                                  | 385                | 0.02                            | 0.18                             |
|               |                          | 18                    | 9,600  | 375                | 0.03                            | 0.23                             | 9,600                                  | 450                | 0.015                           | 0.16                             | 9,500                                  | 370                | 0.01                            | 0.13                             | 7,150                                  | 185                | 0.01                            | 0.13                             |
|               |                          | 20                    | 9,300  | 350                | 0.027                           | 0.21                             | 9,050                                  | 420                | 0.014                           | 0.15                             | 9,000                                  | 330                | 0.009                           | 0.12                             | 6,750                                  | 165                | 0.009                           | 0.12                             |
|               |                          | 22                    | 9,000  | 320                | 0.025                           | 0.2                              | 8,500                                  | 400                | 0.012                           | 0.14                             | 8,500                                  | 290                | 0.008                           | 0.15                             | 6,400                                  | 145                | 0.008                           | 0.15                             |
|               |                          | 25                    | 8,500  | 280                | 0.02                            | 0.18                             | 7,750                                  | 320                | 0.01                            | 0.1                              | 7,750                                  | 220                | 0.007                           | 0.09                             | 5,800                                  | 110                | 0.007                           | 0.09                             |
| 30            | 8,000                    | 240                   | 0.015  | 0.15               | 7,000                           | 250                              | 0.009                                  | 0.07               | 7,000                           | 160                              | 0.006                                  | 0.06               | 5,250                           | 80                               | 0.006                                  | 0.06               |                                 |                                  |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for HSLB / HSLB-S

| WORK MATERIAL |                          |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX (~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                             | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2020          | R1                       | 3                     | 28,000   | 2,900              | 0.3                             | 0.7                              | 14,000                                 | 2,100              | 0.15                            | 0.5                              | 12,250                                 | 1,800              | 0.08                            | 0.35                             | 9,200                                  | 900                | 0.08                            | 0.35                             |
|               |                          | 4                     | 28,000   | 2,900              | 0.3                             | 0.7                              | 14,000                                 | 2,100              | 0.15                            | 0.5                              | 12,250                                 | 1,800              | 0.08                            | 0.35                             | 9,200                                  | 900                | 0.08                            | 0.35                             |
|               |                          | 6                     | 28,000   | 2,900              | 0.2                             | 0.6                              | 14,000                                 | 2,100              | 0.1                             | 0.4                              | 12,250                                 | 1,800              | 0.06                            | 0.3                              | 9,200                                  | 900                | 0.06                            | 0.3                              |
|               |                          | 8                     | 28,000   | 2,900              | 0.2                             | 0.6                              | 14,000                                 | 2,100              | 0.1                             | 0.4                              | 12,250                                 | 1,800              | 0.06                            | 0.3                              | 9,200                                  | 900                | 0.06                            | 0.3                              |
|               |                          | 10                    | 28,000   | 2,900              | 0.2                             | 0.6                              | 14,000                                 | 2,100              | 0.1                             | 0.4                              | 12,250                                 | 1,800              | 0.06                            | 0.3                              | 9,200                                  | 900                | 0.06                            | 0.3                              |
|               |                          | 12                    | 19,500   | 1,350              | 0.12                            | 0.45                             | 12,400                                 | 1,350              | 0.06                            | 0.34                             | 11,500                                 | 1,100              | 0.045                           | 0.27                             | 8,650                                  | 550                | 0.045                           | 0.27                             |
|               |                          | 13                    | 19,500   | 1,350              | 0.12                            | 0.45                             | 12,400                                 | 1,350              | 0.06                            | 0.34                             | 11,500                                 | 1,100              | 0.045                           | 0.27                             | 8,650                                  | 550                | 0.045                           | 0.27                             |
|               |                          | 14                    | 19,500   | 1,350              | 0.12                            | 0.45                             | 12,400                                 | 1,350              | 0.06                            | 0.34                             | 11,500                                 | 1,100              | 0.045                           | 0.27                             | 8,650                                  | 550                | 0.045                           | 0.27                             |
|               |                          | 16                    | 10,800   | 500                | 0.05                            | 0.3                              | 10,800                                 | 600                | 0.03                            | 0.24                             | 10,700                                 | 490                | 0.03                            | 0.24                             | 8,000                                  | 245                | 0.03                            | 0.24                             |
|               |                          | 18                    | 9,700  | 435                | 0.04                            | 0.28                             | 9,700                                  | 520                | 0.025                           | 0.22                             | 9,650                                  | 430                | 0.025                           | 0.22                             | 7,250                                  | 215                | 0.025                           | 0.22                             |
|               |                          | 20                    | 8,650  | 375                | 0.035                           | 0.25                             | 8,650                                  | 450                | 0.02                            | 0.19                             | 8,560                                  | 370                | 0.02                            | 0.19                             | 6,400                                  | 185                | 0.02                            | 0.19                             |
|               |                          | 22                    | 8,450  | 350                | 0.032                           | 0.245                            | 8,200                                  | 440                | 0.018                           | 0.18                             | 8,200                                  | 330                | 0.018                           | 0.18                             | 6,150                                  | 165                | 0.018                           | 0.18                             |
|               |                          | 25                    | 8,250  | 320                | 0.03                            | 0.24                             | 7,800                                  | 440                | 0.016                           | 0.16                             | 7,800                                  | 290                | 0.016                           | 0.16                             | 5,850                                  | 145                | 0.016                           | 0.16                             |
|               |                          | 27                    | 8,050  | 300                | 0.027                           | 0.22                             | 7,400                                  | 390                | 0.015                           | 0.16                             | 7,400                                  | 250                | 0.015                           | 0.16                             | 5,550                                  | 120                | 0.015                           | 0.16                             |
|               |                          | 30                    | 7,850  | 280                | 0.024                           | 0.2                              | 7,000                                  | 350                | 0.014                           | 0.16                             | 7,000                                  | 220                | 0.014                           | 0.16                             | 5,250                                  | 110                | 0.014                           | 0.16                             |
|               |                          | 32                    | 7,650  | 260                | 0.02                            | 0.18                             | 6,550                                  | 300                | 0.012                           | 0.12                             | 6,550                                  | 190                | 0.012                           | 0.12                             | 4,900                                  | 90                 | 0.012                           | 0.12                             |
| 35            | 7,450                    | 240                   | 0.016  | 0.16               | 6,150                           | 250                              | 0.01                                   | 0.09               | 6,150                           | 160                              | 0.01                                   | 0.09               | 4,600                           | 80                               | 0.01                                   | 0.09               |                                 |                                  |
| 40            | 7,000                    | 200                   | 0.01   | 0.06               | 5,250                           | 150                              | 0.006                                  | 0.04               | 5,250                           | 100                              | 0.006                                  | 0.04               | 3,950                           | 50                               | 0.006                                  | 0.04               |                                 |                                  |
| 2025          | R1.25                    | 6                     | 25,000   | 3,000              | 0.35                            | 0.85                             | 12,400                                 | 2,200              | 0.17                            | 0.6                              | 11,000                                 | 1,850              | 0.1                             | 0.45                             | 8,250                                  | 920                | 0.1                             | 0.45                             |
|               |                          | 8                     | 25,000   | 3,000              | 0.24                            | 0.76                             | 12,400                                 | 2,200              | 0.13                            | 0.51                             | 11,000                                 | 1,850              | 0.08                            | 0.38                             | 8,250                                  | 920                | 0.08                            | 0.38                             |
|               |                          | 10                    | 25,000   | 3,000              | 0.24                            | 0.76                             | 12,400                                 | 2,200              | 0.13                            | 0.51                             | 11,000                                 | 1,850              | 0.08                            | 0.38                             | 8,250                                  | 920                | 0.08                            | 0.38                             |
|               |                          | 15                    | 17,300   | 1,400              | 0.145                           | 0.57                             | 11,000                                 | 1,400              | 0.08                            | 0.44                             | 10,300                                 | 1,140              | 0.06                            | 0.35                             | 7,700                                  | 570                | 0.06                            | 0.35                             |
|               |                          | 20                    | 9,600  | 520                | 0.06                            | 0.38                             | 9,600                                  | 630                | 0.04                            | 0.31                             | 9,600                                  | 510                | 0.04                            | 0.31                             | 7,200                                  | 255                | 0.04                            | 0.31                             |
|               |                          | 25                    | 6,900  | 375                | 0.042                           | 0.32                             | 6,900                                  | 450                | 0.024                           | 0.235                            | 6,840                                  | 370                | 0.024                           | 0.235                            | 5,150                                  | 185                | 0.024                           | 0.235                            |
|               |                          | 30                    | 6,500  | 320                | 0.025                           | 0.24                             | 6,200                                  | 400                | 0.02                            | 0.22                             | 6,200                                  | 280                | 0.02                            | 0.22                             | 4,650                                  | 140                | 0.02                            | 0.22                             |
| 35            | 6,200                    | 280                   | 0.017  | 0.2                | 5,500                           | 350                              | 0.014                                  | 0.18               | 5,500                           | 220                              | 0.014                                  | 0.18               | 4,150                           | 110                              | 0.014                                  | 0.18               |                                 |                                  |
| 2030          | R1.5                     | 6                     | 21,000   | 3,000              | 0.4                             | 1                                | 10,500                                 | 2,200              | 0.2                             | 0.7                              | 9,200                                  | 1,900              | 0.12                            | 0.55                             | 6,900                                  | 950                | 0.12                            | 0.55                             |
|               |                          | 8                     | 21,000   | 3,000              | 0.4                             | 1                                | 10,500                                 | 2,200              | 0.2                             | 0.7                              | 9,200                                  | 1,900              | 0.12                            | 0.55                             | 6,900                                  | 950                | 0.12                            | 0.55                             |
|               |                          | 10                    | 21,000   | 3,000              | 0.3                             | 0.9                              | 10,500                                 | 2,200              | 0.15                            | 0.65                             | 9,200                                  | 1,900              | 0.1                             | 0.5                              | 6,900                                  | 950                | 0.1                             | 0.5                              |
|               |                          | 12                    | 21,000   | 3,000              | 0.3                             | 0.9                              | 10,500                                 | 2,200              | 0.15                            | 0.65                             | 9,200                                  | 1,900              | 0.1                             | 0.5                              | 6,900                                  | 950                | 0.1                             | 0.5                              |
|               |                          | 14                    | 21,000   | 3,000              | 0.3                             | 0.9                              | 10,500                                 | 2,200              | 0.15                            | 0.65                             | 9,200                                  | 1,900              | 0.1                             | 0.5                              | 6,900                                  | 950                | 0.1                             | 0.5                              |
|               |                          | 15                    | 21,000   | 3,000              | 0.3                             | 0.9                              | 10,500                                 | 2,200              | 0.15                            | 0.65                             | 9,200                                  | 1,900              | 0.1                             | 0.5                              | 6,900                                  | 950                | 0.1                             | 0.5                              |
|               |                          | 16                    | 21,000   | 3,000              | 0.3                             | 0.9                              | 10,500                                 | 2,200              | 0.15                            | 0.65                             | 9,200                                  | 1,900              | 0.1                             | 0.5                              | 6,900                                  | 950                | 0.1                             | 0.5                              |
|               |                          | 18                    | 17,750   | 2,180              | 0.24                            | 0.8                              | 9,800                                  | 1,800              | 0.13                            | 0.57                             | 8,900                                  | 1,500              | 0.08                            | 0.47                             | 6,650                                  | 760                | 0.08                            | 0.47                             |
|               |                          | 20                    | 14,500   | 1,360              | 0.18                            | 0.7                              | 9,250                                  | 1,400              | 0.1                             | 0.5                              | 8,600                                  | 1,150              | 0.075                           | 0.45                             | 6,450                                  | 575                | 0.075                           | 0.45                             |
|               |                          | 22                    | 11,250   | 940                | 0.12                            | 0.57                             | 8,625                                  | 1,000              | 0.07                            | 0.44                             | 8,300                                  | 830                | 0.06                            | 0.41                             | 6,200                                  | 410                | 0.06                            | 0.41                             |
|               |                          | 25                    | 8,000  | 520                | 0.07                            | 0.45                             | 8,000                                  | 630                | 0.05                            | 0.38                             | 8,000                                  | 510                | 0.05                            | 0.38                             | 6,000                                  | 255                | 0.05                            | 0.38                             |
|               |                          | 27                    | 6,850  | 440                | 0.06                            | 0.41                             | 6,850                                  | 540                | 0.04                            | 0.33                             | 6,850                                  | 440                | 0.04                            | 0.33                             | 5,100                                  | 220                | 0.04                            | 0.33                             |
|               |                          | 30                    | 5,750  | 375                | 0.05                            | 0.38                             | 5,750                                  | 450                | 0.03                            | 0.29                             | 5,700                                  | 370                | 0.03                            | 0.29                             | 4,275                                  | 185                | 0.03                            | 0.29                             |
|               |                          | 32                    | 5,650  | 350                | 0.045                           | 0.37                             | 5,550                                  | 440                | 0.025                           | 0.28                             | 5,500                                  | 340                | 0.025                           | 0.28                             | 4,100                                  | 170                | 0.025                           | 0.28                             |
| 35            | 5,550                    | 335                   | 0.045  | 0.36               | 5,350                           | 440                              | 0.025                                  | 0.27               | 5,350                           | 310                              | 0.025                                  | 0.27               | 4,000                           | 155                              | 0.025                                  | 0.27               |                                 |                                  |
| 40            | 5,350                    | 300                   | 0.04   | 0.34               | 4,900                           | 390                              | 0.02                                   | 0.24               | 4,850                           | 250                              | 0.02                                   | 0.24               | 3,650                           | 125                              | 0.02                                   | 0.24               |                                 |                                  |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for HSLB / HSLB-S

| WORK MATERIAL |                          |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX (~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                                 |                                  | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                             | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2035          | R1.75                    | 10                    | 19,000   | 3,000              | 0.35                            | 1.05                             | 10,000                                 | 2,200              | 0.17                            | 0.75                             | 8,400                                  | 1,900              | 0.11                            | 0.61                             | 6,300                                  | 950                | 0.11                            | 0.61                             |
|               |                          | 15                    | 19,000   | 3,000              | 0.35                            | 1.05                             | 10,000                                 | 2,200              | 0.17                            | 0.75                             | 8,400                                  | 1,900              | 0.11                            | 0.61                             | 6,300                                  | 950                | 0.11                            | 0.61                             |
|               |                          | 20                    | 19,000   | 3,000              | 0.35                            | 1.05                             | 10,000                                 | 2,200              | 0.17                            | 0.75                             | 8,400                                  | 1,900              | 0.11                            | 0.61                             | 6,300                                  | 950                | 0.11                            | 0.61                             |
|               |                          | 25                    | 13,000   | 1,750              | 0.21                            | 0.83                             | 8,450                                  | 1,400              | 0.11                            | 0.61                             | 7,650                                  | 1,200              | 0.08                            | 0.52                             | 5,750                                  | 600                | 0.08                            | 0.52                             |
|               |                          | 30                    | 6,900  | 520                | 0.08                            | 0.52                             | 6,900                                  | 630                | 0.06                            | 0.45                             | 6,900                                  | 510                | 0.06                            | 0.45                             | 5,200                                  | 255                | 0.06                            | 0.45                             |
|               |                          | 40                    | 5,750  | 410                | 0.06                            | 0.45                             | 5,550                                  | 510                | 0.04                            | 0.37                             | 5,500                                  | 380                | 0.04                            | 0.37                             | 4,150                                  | 190                | 0.04                            | 0.37                             |
|               |                          | 45                    | 4,600  | 300                | 0.045                           | 0.39                             | 4,200                                  | 390                | 0.025                           | 0.29                             | 4,100                                  | 250                | 0.025                           | 0.29                             | 3,100                                  | 125                | 0.025                           | 0.29                             |
| 2040          | R2                       | 8                     | 18,000   | 3,200              | 0.5                             | 1.3                              | 9,000                                  | 2,300              | 0.25                            | 0.95                             | 7,900                                  | 2,000              | 0.15                            | 0.75                             | 5,900                                  | 1,000              | 0.15                            | 0.75                             |
|               |                          | 10                    | 18,000   | 3,200              | 0.5                             | 1.3                              | 9,000                                  | 2,300              | 0.25                            | 0.95                             | 7,900                                  | 2,000              | 0.15                            | 0.75                             | 5,900                                  | 1,000              | 0.15                            | 0.75                             |
|               |                          | 12                    | 18,000   | 3,200              | 0.4                             | 1.2                              | 9,000                                  | 2,300              | 0.2                             | 0.85                             | 7,900                                  | 2,000              | 0.13                            | 0.7                              | 5,900                                  | 1,000              | 0.13                            | 0.7                              |
|               |                          | 14                    | 18,000   | 3,200              | 0.4                             | 1.2                              | 9,000                                  | 2,300              | 0.2                             | 0.85                             | 7,900                                  | 2,000              | 0.13                            | 0.7                              | 5,900                                  | 1,000              | 0.13                            | 0.7                              |
|               |                          | 15                    | 18,000   | 3,200              | 0.4                             | 1.2                              | 9,000                                  | 2,300              | 0.2                             | 0.85                             | 7,900                                  | 2,000              | 0.13                            | 0.7                              | 5,900                                  | 1,000              | 0.13                            | 0.7                              |
|               |                          | 16                    | 18,000   | 3,200              | 0.4                             | 1.2                              | 9,000                                  | 2,300              | 0.2                             | 0.85                             | 7,900                                  | 2,000              | 0.13                            | 0.7                              | 5,900                                  | 1,000              | 0.13                            | 0.7                              |
|               |                          | 18                    | 18,000   | 3,200              | 0.4                             | 1.2                              | 9,000                                  | 2,300              | 0.2                             | 0.85                             | 7,900                                  | 2,000              | 0.13                            | 0.7                              | 5,900                                  | 1,000              | 0.13                            | 0.7                              |
|               |                          | 20                    | 18,000   | 3,200              | 0.4                             | 1.2                              | 9,000                                  | 2,300              | 0.2                             | 0.85                             | 7,900                                  | 2,000              | 0.13                            | 0.7                              | 5,900                                  | 1,000              | 0.13                            | 0.7                              |
|               |                          | 22                    | 15,000   | 2,350              | 0.32                            | 1.05                             | 8,500                                  | 1,850              | 0.16                            | 0.75                             | 7,650                                  | 1,600              | 0.11                            | 0.6                              | 5,750                                  | 810                | 0.11                            | 0.6                              |
|               |                          | 25                    | 12,500   | 1,500              | 0.25                            | 0.95                             | 8,000                                  | 1,450              | 0.13                            | 0.7                              | 7,450                                  | 1,250              | 0.09                            | 0.55                             | 5,600                                  | 625                | 0.09                            | 0.55                             |
|               |                          | 27                    | 9,750  | 1,000              | 0.17                            | 0.76                             | 7,500                                  | 1,050              | 0.09                            | 0.55                             | 7,200                                  | 890                | 0.07                            | 0.5                              | 5,400                                  | 440                | 0.07                            | 0.5                              |
|               |                          | 30                    | 7,000  | 550                | 0.1                             | 0.6                              | 7,000                                  | 660                | 0.06                            | 0.45                             | 7,000                                  | 540                | 0.06                            | 0.45                             | 5,250                                  | 270                | 0.06                            | 0.45                             |
|               |                          | 32                    | 6,500  | 535                | 0.09                            | 0.59                             | 6,500                                  | 640                | 0.055                           | 0.44                             | 6,500                                  | 520                | 0.055                           | 0.44                             | 4,850                                  | 260                | 0.055                           | 0.44                             |
|               |                          | 35                    | 6,000  | 520                | 0.09                            | 0.59                             | 6,000                                  | 630                | 0.055                           | 0.43                             | 6,000                                  | 510                | 0.055                           | 0.43                             | 4,500                                  | 255                | 0.055                           | 0.43                             |
|               |                          | 40                    | 4,300  | 375                | 0.065                           | 0.5                              | 4,300                                  | 450                | 0.04                            | 0.39                             | 4,300                                  | 370                | 0.04                            | 0.39                             | 3,200                                  | 185                | 0.04                            | 0.39                             |
|               |                          | 45                    | 4,150  | 330                | 0.058                           | 0.47                             | 4,000                                  | 440                | 0.033                           | 0.36                             | 4,000                                  | 300                | 0.033                           | 0.36                             | 3,000                                  | 150                | 0.033                           | 0.36                             |
| 50            | 4,000                    | 300                   | 0.053  | 0.44               | 3,750                           | 400                              | 0.03                                   | 0.33               | 3,750                           | 260                              | 0.03                                   | 0.33               | 2,800                           | 130                              | 0.03                                   | 0.33               |                                 |                                  |
| 60            | 3,900                    | 280                   | 0.048  | 0.4                | 3,500                           | 350                              | 0.028                                  | 0.3                | 3,500                           | 220                              | 0.028                                  | 0.3                | 2,600                           | 110                              | 0.028                                  | 0.3                |                                 |                                  |
| 2050          | R2.5                     | 10                    | 14,400   | 3,200              | 0.5                             | 1.5                              | 7,200                                  | 2,300              | 0.25                            | 1.05                             | 6,350                                  | 2,000              | 0.16                            | 0.88                             | 4,750                                  | 1,000              | 0.16                            | 0.88                             |
|               |                          | 15                    | 14,400   | 3,200              | 0.5                             | 1.5                              | 7,200                                  | 2,300              | 0.25                            | 1.05                             | 6,350                                  | 2,000              | 0.16                            | 0.88                             | 4,750                                  | 1,000              | 0.16                            | 0.88                             |
|               |                          | 20                    | 14,400   | 3,200              | 0.5                             | 1.5                              | 7,200                                  | 2,300              | 0.25                            | 1.05                             | 6,350                                  | 2,000              | 0.16                            | 0.88                             | 4,750                                  | 1,000              | 0.16                            | 0.88                             |
|               |                          | 25                    | 12,200   | 2,350              | 0.405                           | 1.35                             | 6,800                                  | 1,850              | 0.205                           | 0.95                             | 6,250                                  | 1,600              | 0.135                           | 0.805                            | 4,650                                  | 800                | 0.135                           | 0.805                            |
|               |                          | 30                    | 10,000   | 1,500              | 0.31                            | 1.2                              | 6,400                                  | 1,450              | 0.16                            | 0.88                             | 6,200                                  | 1,250              | 0.11                            | 0.73                             | 4,650                                  | 625                | 0.11                            | 0.73                             |
|               |                          | 35                    | 8,000  | 1,050              | 0.21                            | 1                                | 6,200                                  | 1,070              | 0.12                            | 0.76                             | 6,100                                  | 900                | 0.095                           | 0.68                             | 4,600                                  | 450                | 0.095                           | 0.68                             |
|               |                          | 40                    | 6,000  | 570                | 0.125                           | 0.78                             | 6,000                                  | 690                | 0.08                            | 0.625                            | 6,000                                  | 570                | 0.08                            | 0.625                            | 4,500                                  | 285                | 0.08                            | 0.625                            |
|               |                          | 45                    | 5,150  | 500                | 0.11                            | 0.72                             | 5,150                                  | 600                | 0.07                            | 0.4                              | 5,100                                  | 500                | 0.07                            | 0.4                              | 3,800                                  | 250                | 0.07                            | 0.4                              |
|               |                          | 50                    | 4,300  | 430                | 0.09                            | 0.65                             | 4,300                                  | 510                | 0.06                            | 0.18                             | 4,200                                  | 435                | 0.06                            | 0.18                             | 3,150                                  | 215                | 0.06                            | 0.18                             |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

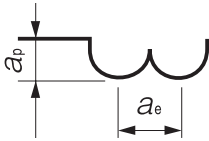
Spiral V Cutter

Drill

Technical Data

## Milling Conditions for HSLB / HSLB-S

| WORK MATERIAL |                          |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / STAVAX (~55HRC) |                    |                        |                         | HARDENED STEELS<br>SKD11<br>(55~62HRC) |                    |                        |                         | HARDENED STEELS<br>HAP10<br>(62~66HRC) |                    |                        |                         | HARDENED STEELS<br>HAP72<br>(66~70HRC) |                    |                        |                         |
|---------------|--------------------------|-----------------------|--|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|--|--------------------|------------------------|-------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                             | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )     | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2060          | R3                       | 10                    | 13,000   | 3,500              | 0.6                    | 1.8                     | 6,500                                  | 2,500              | 0.3                    | 1.3                     | 5,700                                  | 2,200              | 0.2                    | 1                       | 4,300                                  | 1,100              | 0.2                    | 1                       |
|               |                          | 15                    | 13,000   | 3,500              | 0.6                    | 1.8                     | 6,500                                  | 2,500              | 0.3                    | 1.3                     | 5,700                                  | 2,200              | 0.2                    | 1                       | 4,300                                  | 1,100              | 0.2                    | 1                       |
|               |                          | 18                    | 13,000   | 3,500              | 0.6                    | 1.8                     | 6,500                                  | 2,500              | 0.3                    | 1.3                     | 5,700                                  | 2,200              | 0.2                    | 1                       | 4,300                                  | 1,100              | 0.2                    | 1                       |
|               |                          | 20                    | 13,000   | 3,500              | 0.6                    | 1.8                     | 6,500                                  | 2,500              | 0.3                    | 1.3                     | 5,700                                  | 2,200              | 0.2                    | 1                       | 4,300                                  | 1,100              | 0.2                    | 1                       |
|               |                          | 22                    | 13,000   | 3,500              | 0.6                    | 1.8                     | 6,500                                  | 2,500              | 0.3                    | 1.3                     | 5,700                                  | 2,200              | 0.2                    | 1                       | 4,300                                  | 1,100              | 0.2                    | 1                       |
|               |                          | 25                    | 13,000   | 3,500              | 0.6                    | 1.8                     | 6,500                                  | 2,500              | 0.3                    | 1.3                     | 5,700                                  | 2,200              | 0.2                    | 1                       | 4,300                                  | 1,100              | 0.2                    | 1                       |
|               |                          | 27                    | 13,000   | 3,500              | 0.6                    | 1.8                     | 6,500                                  | 2,500              | 0.3                    | 1.3                     | 5,700                                  | 2,200              | 0.2                    | 1                       | 4,300                                  | 1,100              | 0.2                    | 1                       |
|               |                          | 30                    | 13,000   | 3,500              | 0.6                    | 1.8                     | 6,500                                  | 2,500              | 0.3                    | 1.3                     | 5,700                                  | 2,200              | 0.2                    | 1                       | 4,300                                  | 1,100              | 0.2                    | 1                       |
|               |                          | 32                    | 12,000   | 3,100              | 0.54                   | 1.7                     | 6,300                                  | 2,250              | 0.27                   | 1.15                    | 5,600                                  | 2,000              | 0.18                   | 0.9                     | 4,200                                  | 1,000              | 0.18                   | 0.9                     |
|               |                          | 35                    | 11,000   | 2,750              | 0.48                   | 1.6                     | 6,100                                  | 2,050              | 0.25                   | 1.05                    | 5,500                                  | 1,800              | 0.175                  | 0.8                     | 4,150                                  | 900                | 0.175                  | 0.8                     |
|               |                          | 40                    | 9,000  | 2,050              | 0.375                  | 1.35                    | 5,750                                  | 1,600              | 0.2                    | 0.8                     | 5,350                                  | 1,400              | 0.15                   | 0.65                    | 4,000                                  | 700                | 0.15                   | 0.65                    |
|               |                          | 45                    | 7,000  | 1,300              | 0.26                   | 1.1                     | 5,350                                  | 1,150              | 0.15                   | 0.55                    | 5,150                                  | 1,000              | 0.125                  | 0.45                    | 3,850                                  | 500                | 0.125                  | 0.45                    |
| 50            | 5,000                    | 600                   | 0.15   | 0.9                | 5,000                  | 720                     | 0.1                                    | 0.3                | 5,000                  | 600                     | 0.1                                    | 0.3                | 3,750                  | 300                     | 0.1                                    | 0.3                |                        |                         |
| 60            | 3,600                    | 430                   | 0.105  | 0.75               | 3,600                  | 510                     | 0.08                                   | 0.22               | 3,550                  | 435                     | 0.08                                   | 0.22               | 2,650                  | 215                     | 0.08                                   | 0.22               |                        |                         |



- Note:
- Decrease the feed rate more than 50% from the milling parameters when slot milling.
  - Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum speed, or when the tool is chattering and heats up to a red color.
  - Every coolant offers stable milling.

∅3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.1~R3

Short Shank Series

# HSLB-S



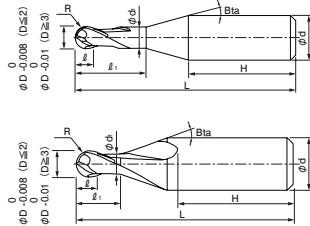
Back taper geometry does not apply to R0.4 or below, and  $\ell_1 / D \leq 10$ .

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

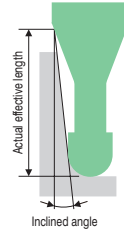
| Work Material                 |                                 |                                  |                 |         |         |         |         |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|---------|---------|---------|---------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |         |         |         |         | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~ 50HRC         | ~ 55HRC | ~ 60HRC | ~ 65HRC | ~ 70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●       | ●       | ○       | ○       |           |                 | ○        |        |          |                       | ○               | ○                     |                  |                                       |

### Features

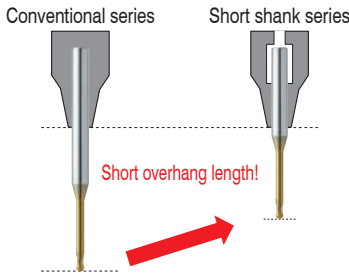
- 1 Short shank for high accuracy shrink-fit holder.
- 2 Variable rake angle design Optimized rake angles are designed from the ball tip to the peripheral cutting edge.
- 3 HARDMAX Coating HARDMAX coating offers heat resistance, durability and lubricity at a high level.
- 4 Suitable for various coolant types. Every coolant offers stable milling.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



### Short overhang length with short shank length!



Short overhang length minimizes tool run-out

- High precision milling
- Minimizes chattering
- Longer tool life

Ideal for tool holders where the maximum insertion is short.

### Tighter Tolerance Design! Diameter Tolerance, Ball Radius Accuracy, and Shank Diameter Tolerance

HSB / HSLB Tolerance

| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy | Shank Diameter Tolerance |
|---------------------|--------------------|----------------------|--------------------------|
| R0.1 ~ R3           | 0/-0.015           | ±0.005               | 0/-0.005 (h5)            |

HSB-S / HSLB-S Tolerance

| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy | Shank Diameter Tolerance |
|---------------------|--------------------|----------------------|--------------------------|
| R0.1 ~ R1           | <b>0/-0.008</b>    | ±0.003               | <b>0/-0.004 (h4)</b>     |
| R1.5 ~ R2           | <b>0/-0.01</b>     |                      |                          |
| R3                  |                    | ±0.005               |                          |

Shank diameter tolerance h4!



Total 61 models

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Shank Length H | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |       |       |
|-----------------|-----------------------|------------------------|-------------------|--------------------------|---------------------------|------------------|-------------------------|----------------|--------------------------|-------------------------------------|-------|-------|-------|-------|
|                 |                       |                        |                   |                          |                           |                  |                         |                |                          | 30°                                 | 1°    | 1°30' | 2°    | 3°    |
| HSLB 2002-005S  | RO.1                  | 0.5                    | 0.16              | 0.19                     | 16°                       | 35               | 4                       | 26.0           | 6,470                    | 0.63                                | 0.66  | 0.68  | 0.71  | 0.76  |
| HSLB 2002-010S  |                       | 1                      |                   |                          |                           | 35               | 4                       | 25.5           | 6,470                    | 1.15                                | 1.20  | 1.24  | 1.28  | 1.37  |
| HSLB 2003-005S  | RO.15                 | 0.5                    | 0.24              | 0.29                     | 16°                       | 35               | 4                       | 26.0           | 6,380                    | 0.63                                | 0.65  | 0.68  | 0.70  | 0.75  |
| HSLB 2003-0075S |                       | 0.75                   |                   |                          |                           | 35               | 4                       | 26.0           | 6,380                    | 0.89                                | 0.92  | 0.96  | 0.99  | 1.05  |
| HSLB 2003-010S  |                       | 1                      |                   |                          |                           | 35               | 4                       | 25.5           | 6,380                    | 1.15                                | 1.19  | 1.23  | 1.27  | 1.36  |
| HSLB 2003-015S  |                       | 1.5                    |                   |                          |                           | 35               | 4                       | 25.0           | 6,840                    | 1.66                                | 1.72  | 1.77  | 1.83  | 1.96  |
| HSLB 2004-005S  | RO.2                  | 0.5                    | 0.32              | 0.39                     | 16°                       | 35               | 4                       | 26.5           | 4,380                    | 0.63                                | 0.65  | 0.67  | 0.70  | 0.74  |
| HSLB 2004-010S  |                       | 1                      |                   |                          |                           | 35               | 4                       | 26.0           | 4,380                    | 1.15                                | 1.19  | 1.23  | 1.26  | 1.35  |
| HSLB 2004-015S  |                       | 1.5                    |                   |                          |                           | 35               | 4                       | 25.5           | 4,470                    | 1.66                                | 1.71  | 1.77  | 1.82  | 1.95  |
| HSLB 2004-020S  |                       | 2                      |                   |                          |                           | 35               | 4                       | 25.0           | 4,560                    | 2.18                                | 2.25  | 2.32  | 2.39  | 2.56  |
| HSLB 2004-025S  |                       | 2.5                    |                   |                          |                           | 35               | 4                       | 24.5           | 4,740                    | 2.70                                | 2.78  | 2.87  | 2.96  | 3.17  |
| HSLB 2004-030S  |                       | 3                      |                   |                          |                           | 35               | 4                       | 24.0           | 5,020                    | 3.21                                | 3.31  | 3.42  | 3.53  | 3.79  |
| HSLB 2005-010S  | RO.25                 | 1                      | 0.4               | 0.49                     | 16°                       | 35               | 4                       | 26.0           | 4,380                    | 1.15                                | 1.19  | 1.22  | 1.26  | 1.34  |
| HSLB 2005-015S  |                       | 1.5                    |                   |                          |                           | 35               | 4                       | 25.5           | 4,380                    | 1.65                                | 1.71  | 1.76  | 1.82  | 1.94  |
| HSLB 2005-020S  |                       | 2                      |                   |                          |                           | 35               | 4                       | 25.0           | 4,380                    | 2.18                                | 2.24  | 2.31  | 2.39  | 2.55  |
| HSLB 2005-025S  |                       | 2.5                    |                   |                          |                           | 35               | 4                       | 24.5           | 4,380                    | 2.69                                | 2.78  | 2.86  | 2.96  | 3.16  |
| HSLB 2005-030S  |                       | 3                      |                   |                          |                           | 35               | 4                       | 24.0           | 4,380                    | 3.21                                | 3.31  | 3.41  | 3.53  | 3.77  |
| HSLB 2006-010S  | RO.3                  | 1                      | 0.48              | 0.59                     | 16°                       | 35               | 4                       | 26.0           | 3,740                    | 1.14                                | 1.18  | 1.22  | 1.25  | 1.33  |
| HSLB 2006-015S  |                       | 1.5                    |                   |                          |                           | 35               | 4                       | 25.5           | 3,380                    | 1.65                                | 1.71  | 1.76  | 1.81  | 1.93  |
| HSLB 2006-020S  |                       | 2                      |                   |                          |                           | 35               | 4                       | 25.0           | 3,380                    | 2.17                                | 2.24  | 2.31  | 2.38  | 2.54  |
| HSLB 2006-030S  |                       | 3                      |                   |                          |                           | 35               | 4                       | 24.0           | 3,460                    | 3.21                                | 3.31  | 3.41  | 3.52  | 3.76  |
| HSLB 2006-040S  |                       | 4                      |                   |                          |                           | 40               | 4                       | 28.0           | 3,560                    | 4.24                                | 4.37  | 4.51  | 4.66  | 4.99  |
| HSLB 2006-050S  |                       | 5                      |                   |                          |                           | 40               | 4                       | 27.0           | 3,560                    | 5.27                                | 5.44  | 5.61  | 5.80  | 6.21  |
| HSLB 2006-060S  |                       | 6                      |                   |                          |                           | 40               | 4                       | 26.0           | 3,560                    | 6.30                                | 6.50  | 6.71  | 6.93  | 7.43  |
| HSLB 2008-020S  | RO.4                  | 2                      | 0.64              | 0.79                     | 16°                       | 35               | 4                       | 25.5           | 3,380                    | 2.17                                | 2.23  | 2.30  | 2.37  | 2.52  |
| HSLB 2008-030S  |                       | 3                      |                   |                          |                           | 35               | 4                       | 24.5           | 3,560                    | 3.21                                | 3.30  | 3.40  | 3.50  | 3.74  |
| HSLB 2008-040S  |                       | 4                      |                   |                          |                           | 35               | 4                       | 23.5           | 3,560                    | 4.24                                | 4.36  | 4.50  | 4.64  | 4.97  |
| HSLB 2008-060S  |                       | 6                      |                   |                          |                           | 40               | 4                       | 26.5           | 3,560                    | 6.30                                | 6.49  | 6.70  | 6.92  | 7.41  |
| HSLB 2010-020S  | RO.5                  | 2                      | 0.8               | 0.98                     | 16°                       | 35               | 4                       | 25.5           | 2,820                    | 2.18                                | 2.24  | 2.30  | 2.36  | 2.51  |
| HSLB 2010-025S  |                       | 2.5                    |                   |                          |                           | 35               | 4                       | 25.0           | 2,820                    | 2.70                                | 2.77  | 2.85  | 2.93  | 3.12  |
| HSLB 2010-030S  |                       | 3                      |                   |                          |                           | 35               | 4                       | 24.5           | 2,820                    | 3.21                                | 3.30  | 3.40  | 3.50  | 3.73  |
| HSLB 2010-040S  |                       | 4                      |                   |                          |                           | 35               | 4                       | 23.5           | 3,190                    | 4.24                                | 4.37  | 4.50  | 4.64  | 4.96  |
| HSLB 2010-060S  |                       | 6                      |                   |                          |                           | 40               | 4                       | 26.5           | 3,460                    | 6.31                                | 6.50  | 6.70  | 6.92  | 7.40  |
| HSLB 2010-080S  |                       | 8                      |                   |                          |                           | 40               | 4                       | 24.5           | 3,460                    | 8.37                                | 8.63  | 8.90  | 9.20  | 9.85  |
| HSLB 2015-030S  | RO.75                 | 3                      | 1.2               | 1.47                     | 16°                       | 35               | 4                       | 25.5           | 3,280                    | 3.10                                | 3.18  | 3.26  | 3.35  | 3.55  |
| HSLB 2015-040S  |                       | 4                      |                   |                          |                           | 35               | 4                       | 24.5           | 3,280                    | 4.13                                | 4.24  | 4.36  | 4.49  | 4.77  |
| HSLB 2015-060S  |                       | 6                      |                   |                          |                           | 40               | 4                       | 27.5           | 3,280                    | 6.19                                | 6.37  | 6.56  | 6.76  | 7.22  |
| HSLB 2015-080S  |                       | 8                      |                   |                          |                           | 40               | 4                       | 25.5           | 3,460                    | 8.25                                | 8.50  | 8.76  | 9.04  | 9.67  |
| HSLB 2015-100S  |                       | 10                     |                   |                          |                           | 40               | 4                       | 23.5           | 3,740                    | 10.32                               | 10.63 | 10.96 | 11.32 | 12.11 |

Next Page →

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Unit (mm)

| Model Number     | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bia | Overall Length L | Shank Diameter $\phi d$ | Shank Length H | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|------------------|-----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|----------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|                  |                       |                           |                      |                          |                       |                  |                         |                |                          | 30°                                 | 1°              | 1°30'           | 2°              | 3°              |
| HSLB 2020-030S   | R1                    | 3                         | 1.6                  | 1.98                     | 16°                   | 35               | 4                       | 26.5           | 2,820                    | 3.07                                | 3.14            | 3.21            | 3.29            | 3.47            |
| HSLB 2020-040S   |                       | 4                         |                      |                          |                       | 35               | 4                       | 25.5           | 2,820                    | 4.10                                | 4.20            | 4.31            | 4.43            | 4.70            |
| HSLB 2020-060S   |                       | 6                         |                      |                          |                       | 35               | 4                       | 23.5           | 3,190                    | 6.16                                | 6.33            | 6.51            | 6.71            | 7.14            |
| HSLB 2020-080S   |                       | 8                         |                      |                          |                       | 40               | 4                       | 26.5           | 3,460                    | 8.23                                | 8.46            | 8.72            | 8.99            | 9.59            |
| HSLB 2020-100S   |                       | 10                        |                      |                          |                       | 40               | 4                       | 24.5           | 3,460                    | 10.29                               | 10.59           | 10.92           | 11.26           | 12.04           |
| HSLB 2020-120S   |                       | 12                        |                      |                          |                       | 45               | 4                       | 27.5           | 3,460                    | 12.35                               | 12.72           | 13.12           | 13.54           | 14.48           |
| HSLB 2020-140S   |                       | 14                        |                      |                          |                       | 45               | 4                       | 25.5           | 3,460                    | 14.41                               | 14.85           | 15.32           | 15.82           | 16.93           |
| HSLB 2020-160S   |                       | 16                        |                      |                          |                       | 50               | 4                       | 28.5           | 3,460                    | 16.48                               | 16.98           | 17.52           | 18.10           | 19.38           |
| HSLB 2020-200S   |                       | 20                        |                      |                          |                       | 50               | 4                       | 24.5           | 3,460                    | 20.60                               | 21.24           | 21.92           | 22.65           | No Interference |
| HSLB 2030-060-4S |                       | R1.5                      |                      |                          |                       | 6                | 2.4                     | 2.95           | 16°                      | 35                                  | 4               | 25.0            | 3,460           | 6.20            |
| HSLB 2030-080-4S | 8                     |                           | 40                   | 4                        | 28.0                  | 3,460            |                         |                |                          | 8.26                                | 8.48            | 8.72            | 8.97            | 9.54            |
| HSLB 2030-100-4S | 10                    |                           | 40                   | 4                        | 26.0                  | 4,020            |                         |                |                          | 10.32                               | 10.61           | 10.92           | 11.25           | No Interference |
| HSLB 2030-120-4S | 12                    |                           | 40                   | 4                        | 24.0                  | 4,190            |                         |                |                          | 12.38                               | 12.74           | 13.12           | 13.53           | No Interference |
| HSLB 2030-160-4S | 16                    |                           | 45                   | 4                        | 25.0                  | 4,650            |                         |                |                          | 16.51                               | 17.00           | 17.52           | No Interference | No Interference |
| HSLB 2030-200-4S | 20                    |                           | 50                   | 4                        | 26.0                  | 4,470            |                         |                |                          | 20.64                               | 21.26           | No Interference | No Interference | No Interference |
| HSLB 2040-080-4S | R2                    | 8                         | 3.2                  | 3.95                     | —                     | 35               | 4                       | 24.0           | 3,560                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2040-100-4S |                       | 10                        |                      |                          |                       | 40               | 4                       | 28.0           | 3,560                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2040-120-4S |                       | 12                        |                      |                          |                       | 40               | 4                       | 26.0           | 4,650                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2040-160-4S |                       | 16                        |                      |                          |                       | 45               | 4                       | 27.0           | 4,650                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2040-200-4S |                       | 20                        |                      |                          |                       | 50               | 4                       | 28.0           | 4,650                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-150S   | R3                    | 15                        | 4.8                  | 5.95                     | —                     | 45               | 6                       | 28.0           | 5,840                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| HSLB 2060-200S   |                       | 20                        |                      |                          |                       | 50               | 6                       | 28.0           | 5,840                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

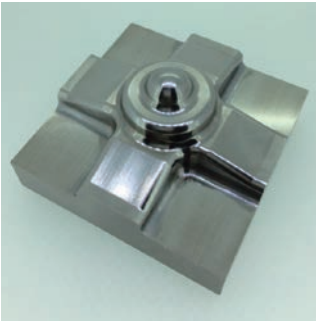
Spiral V Cutter

Drill

Technical Data

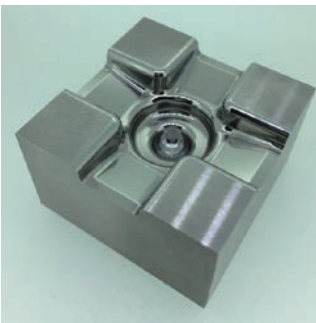
## Milling examples

## SKH51 (63HRC)



Size : 50 x 50 x 30 mm

| No.   | Process        | Tool                    | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Cycle Time (h:m:s) |
|-------|----------------|-------------------------|------------------------------------|--------------------|---------------------|---------------------|--------------------|
| 1     | Roughing       | HMS φ 10 × L22          | 2,000                              | 1,000              | 17.5                | 0.2                 | 0:59:48            |
| 2     | Semi-roughing  | HSB R3                  | 5,700                              | 2,200              | 0.2                 | 0.3                 | 0:37:55            |
| 3     | Semi-roughing  | HSLB R2 × EL8           | 7,900                              | 2,000              | 0.15                | 0.3                 | 0:05:44            |
| 4     | Finishing      | HLRS φ 6 × CR0.1 × EL12 | 4,000                              | 1,080              | —                   | 1.35                | 1:38:31            |
| 5     | Semi-finishing | HSLB R2 × EL8           | 7,900                              | 1,000              | 0.04                | 0.04                | 0:04:08            |
| 6     | Finishing      | HSLB R1.75 × EL10       | 16,800                             | 920                | 0.04                | 0.04                | 2:26:27            |
| 7     | Finishing      | HSLB R1 × EL3           | 12,250                             | 900                | 0.03                | 0.03                | 0:11:17            |
| Total |                |                         |                                    |                    |                     |                     | 6:03:50            |



Size : 50 x 50 x 30 mm

| No.   | Process        | Tool              | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Cycle Time (h:m:s) |
|-------|----------------|-------------------|------------------------------------|--------------------|---------------------|---------------------|--------------------|
| 1     | Roughing       | HSB R5            | 3,750                              | 1,750              | 0.3                 | 1.7                 | 0:35:28            |
| 2     | Semi-roughing  | HSB R3            | 5,700                              | 2,200              | 0.2                 | 0.3                 | 0:29:29            |
| 3     | Semi-roughing  | HSLB R2 × EL8     | 7,900                              | 2,000              | 0.15                | 0.3                 | 0:20:42            |
| 4     | Semi-finishing | HSLB R2 × EL8     | 7,900                              | 1,000              | 0.04                | 0.04                | 1:30:26            |
| 5     | Semi-finishing | HSLB R1.75 × EL10 | 8,400                              | 920                | —                   | —                   | 0:34:04            |
| 6     | Finishing      | HSLB R1.75 × EL10 | 16,800                             | 920                | 0.04                | 0.04                | 2:17:59            |
| 7     | Finishing      | HSLB R1 × EL3     | 12,250                             | 900                | 0.03                | 0.03                | 0:08:02            |
| Total |                |                   |                                    |                    |                     |                     | 5:56:10            |

- Coolant : Air blow, Oil Mist
- R1.75 Surface roughness : Ra 0.10 ~ 0.24 μm (Ave 0.17 μm)

## Surface condition by different milling conditions R1.75 × EL10



|                                      | Milling condition A | Milling condition B | Milling condition C | Milling condition D | Milling condition E |
|--------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Spindle Speed (min <sup>-1</sup> )   | 8,400               |                     |                     |                     | 16,800              |
| Feed Rate (mm/min)                   | 1,900               | 1,390               | 1,230               | 920                 | 920                 |
| a <sub>p</sub> , a <sub>e</sub> (mm) | 0.04                | 0.04                | 0.04                | 0.04                | 0.04                |
| Feed per tooth (mm/t)                | 0.11                | 0.083               | 0.073               | 0.055               | 0.027               |
| Feed rate ratio                      | 100%                | 75%                 | 66%                 | 50%                 | 50%                 |

※ A is based on the catalog milling conditions.

| Milling condition A | Milling condition B | Milling condition C | Milling condition D<br>Good | Milling condition E<br>Excellent |
|---------------------|---------------------|---------------------|-----------------------------|----------------------------------|
|                     |                     |                     |                             |                                  |

Test A ~ D) Compared milling surfaces with 4 different feed rates and the spindle speed of 8,400 min<sup>-1</sup>.

Result . . . The milling surface improved with **reduced feed per tooth**.

Test E) Tested with the double spindle speed of 16,800 min<sup>-1</sup>.

Result . . . The milling surface improved even more (Ra 0.17 μm) with **increased spindle speed**.

Milling condition E was applied to another work.

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball  
Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.05~R3

# CSELB

Super  
MG

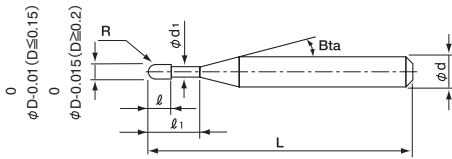
UT  
COAT

Shank Dia  
0/-0.005

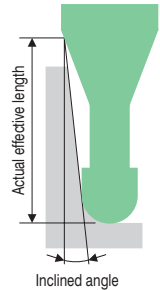
Back Taper  
Geometry

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material |              |                    |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|---------------|--------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels | Alloy Steels | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
| S45C          | SK / SCM     | NAK                | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| S55C          | SUS          | HPM                |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●             | ●            | ●                  | ●               | ●      |        |        |        |           | ○               | ●        | ●      |          |                       |                 | ○                     | ○                |                                       |



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



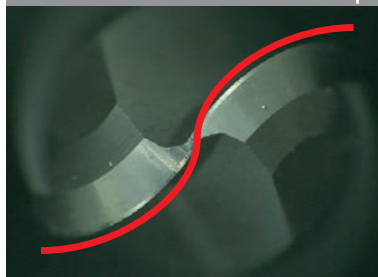
| Radius of Ball Nose | Diameter Tolerance | Ball Radius Accuracy | Helix Angle |
|---------------------|--------------------|----------------------|-------------|
| R0.05 ~ R0.075      | 0/-0.01            | ±0.002               | 0°          |
| R0.1 ~ R3           | 0/-0.015           | ±0.005               | 30°         |

### 3 features of CSELB

Reduce cutting resistance and prioritize surface quality.

Recommended for milling on hardened steels (55HRC) - sticky materials, materials that prone to chatter marks.

Less resistance on curved surface shape



Small relief surface

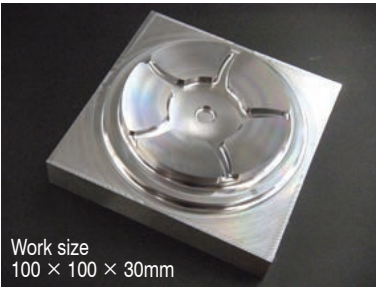


Tip design with excellent cutting performance



## Wheel shape

PX5 (30HRC)



Work size  
100 × 100 × 30mm

Coolant: Water soluble

## Tool

2 flute ball  
**CSEB** (P432)



2 flute long neck ball  
**CSELB**



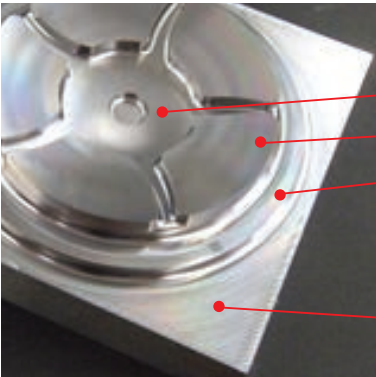
4 flute highly efficient radius  
**CRRS** (P390)



| No | Process        | Tool                | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Allowance (mm) | Cycle Time (h:m:s) |
|----|----------------|---------------------|------------------------------------|--------------------|------------|------------|----------------|--------------------|
| 1  | Roughing       | CSEB R3             | 11,000                             | 2,300              | 0.55       | 1.7        | 0.1            | 0:56:56            |
| 2  |                | CSELB R2 × EL12     | 18,000                             | 2,400              | 0.4        | 1.2        | 0.03           | 0:00:43            |
| 3  | Semi-finishing | CSELB R2 × EL12     | 18,000                             | 3,000              | 0.18       | —          | 0.03           | 0:13:08            |
| 4  |                |                     |                                    |                    | 0.2        | —          | 0.03           | 0:01:54            |
| 5  |                | —                   | 0.12                               | 0.03               | 0:18:57    |            |                |                    |
| 6  |                | CSELB R1 × EL8      | 30,000                             | 2,000              | 0.1        | 0.1        | 0.03           | 0:17:26            |
| No | Process        | Tool                | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Allowance (mm) | Cycle Time (h:m:s) |
| 7  | Finishing      | CRRS $\phi$ 6 × CR1 | 8,000                              | 1,000              | 0.05       | 1          | 0              | 0:14:00            |
| 8  |                | CSELB R1 × EL8      | 30,000                             | 2,000              | 0.04       | —          | —              | 2:31:37            |
| 9  |                |                     |                                    |                    | 0.04       | —          | —              | 0:16:16            |
| 10 |                | —                   | 0.03                               | —                  | —          | 0:59:37    |                |                    |
| 11 |                | 0.04                | 0.04                               | —                  | —          | 0:02:11    |                |                    |

Total 5:52:45

## Measurement of finishing roughness

**CSELB Long neck ball R1 × EL8**

|        |          |
|--------|----------|
| Canter | Ra 0.396 |
| Radius | Ra 0.421 |
| Side   | Ra 0.118 |

**CRRS 4 flute highly efficient radius  $\phi$  6 × CR1**

|              |          |
|--------------|----------|
| Flat surface | Ra 0.091 |
|--------------|----------|

Finishing with CSEB/CSELB offers uniform milling surface.

$\phi$ 3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball  
Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Total 325 models

Unit (mm)

| Model Number     | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bia | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |      |       |        |      |      |      |      |      |
|------------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|------|-------|--------|------|------|------|------|------|
|                  |                       |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°   | 1°30' | 2°     | 3°   |      |      |      |      |
| CSELB 2001-002   | RO.05                 | 0.2                    | 0.08              | 0.095                    | 11°                   | 45               | 4                       | 11,630                   | 0.22                                | 0.24 | 0.26  | 0.28   | 0.31 |      |      |      |      |
| CSELB 2001-003   |                       | 0.3                    |                   |                          |                       | 45               | 4                       | 11,630                   | 0.33                                | 0.35 | 0.38  | 0.40   | 0.45 |      |      |      |      |
| CSELB 2001-005   |                       | 0.5                    |                   |                          |                       | 45               | 4                       | 12,540                   | 0.54                                | 0.58 | 0.61  | 0.64   | 0.72 |      |      |      |      |
| CSELB 20015-003  | RO.075                | 0.3                    | 0.12              | 0.135                    | 11°                   | 45               | 4                       | 13,450                   | 0.36                                | 0.38 | 0.40  | 0.42   | 0.48 |      |      |      |      |
| CSELB 20015-005  |                       | 0.5                    |                   |                          |                       | 45               | 4                       | 14,250                   | 0.58                                | 0.60 | 0.63  | 0.67   | 0.75 |      |      |      |      |
| CSELB 20015-010  |                       | 1                      |                   |                          |                       | 45               | 4                       | 14,820                   | 1.10                                | 1.15 | 1.21  | 1.28   | 1.43 |      |      |      |      |
| CSELB 2002-003   | RO.1                  | 0.3                    | 0.16              | 0.19                     | 11°                   | 45               | 4                       | 8,090                    | 0.40                                | 0.42 | 0.44  | 0.46   | 0.52 |      |      |      |      |
| CSELB 2002-005   |                       | 0.5                    |                   |                          |                       | 45               | 4                       | 8,090                    | 0.61                                | 0.64 | 0.67  | 0.71   | 0.79 |      |      |      |      |
| CSELB 2002-005-6 |                       | 0.5                    |                   |                          |                       | 50               | 6                       | 11,290                   | 0.61                                | 0.64 | 0.67  | 0.71   | 0.79 |      |      |      |      |
| CSELB 2002-0075  |                       | 0.75                   |                   |                          |                       | 45               | 4                       | 8,090                    | 0.87                                | 0.92 | 0.96  | 1.01   | 1.13 |      |      |      |      |
| CSELB 2002-010   |                       | 1                      |                   |                          |                       | 45               | 4                       | 8,090                    | 1.14                                | 1.19 | 1.25  | 1.32   | 1.48 |      |      |      |      |
| CSELB 2002-010-6 |                       | 1                      |                   |                          |                       | 50               | 6                       | 11,290                   | 1.14                                | 1.19 | 1.25  | 1.32   | 1.48 |      |      |      |      |
| CSELB 2002-0125  |                       | 1.25                   |                   |                          |                       | 45               | 4                       | 8,780                    | 1.39                                | 1.45 | 1.53  | 1.61   | 1.80 |      |      |      |      |
| CSELB 2002-015   |                       | 1.5                    |                   |                          |                       | 45               | 4                       | 8,780                    | 1.65                                | 1.73 | 1.81  | 1.91   | 2.14 |      |      |      |      |
| CSELB 2002-015-6 |                       | 1.5                    |                   |                          |                       | 50               | 6                       | 12,250                   | 1.65                                | 1.73 | 1.81  | 1.91   | 2.14 |      |      |      |      |
| CSELB 2002-0175  |                       | 1.75                   |                   |                          |                       | 45               | 4                       | 9,690                    | 1.91                                | 2.00 | 2.10  | 2.22   | 2.49 |      |      |      |      |
| CSELB 2002-020   |                       | 2                      |                   |                          |                       | 45               | 4                       | 9,690                    | 2.17                                | 2.28 | 2.39  | 2.52   | 2.83 |      |      |      |      |
| CSELB 2002-020-6 |                       | 2                      |                   |                          |                       | 50               | 6                       | 13,520                   | 2.17                                | 2.28 | 2.39  | 2.52   | 2.83 |      |      |      |      |
| CSELB 2002-0225  |                       | 2.25                   |                   |                          |                       | 45               | 4                       | 10,600                   | 2.43                                | 2.55 | 2.68  | 2.83   | 3.17 |      |      |      |      |
| CSELB 2002-025   |                       | 2.5                    |                   |                          |                       | 45               | 4                       | 10,600                   | 2.69                                | 2.83 | 2.97  | 3.13   | 3.51 |      |      |      |      |
| CSELB 2002-030   |                       | 3                      |                   |                          |                       | 45               | 4                       | 11,400                   | 3.22                                | 3.37 | 3.55  | 3.74   | 4.20 |      |      |      |      |
| CSELB 2003-005   |                       | RO.15                  |                   |                          |                       | 0.5              | 0.24                    | 0.29                     | 11°                                 | 45   | 4     | 7,980  | 0.61 | 0.64 | 0.67 | 0.70 | 0.77 |
| CSELB 2003-006   |                       |                        |                   |                          |                       | 0.6              |                         |                          |                                     | 45   | 4     | 7,980  | 0.71 | 0.75 | 0.78 | 0.82 | 0.91 |
| CSELB 2003-0075  |                       |                        |                   |                          |                       | 0.75             |                         |                          |                                     | 45   | 4     | 7,980  | 0.87 | 0.91 | 0.95 | 1.00 | 1.12 |
| CSELB 2003-010   |                       |                        |                   |                          |                       | 1                |                         |                          |                                     | 45   | 4     | 7,980  | 1.13 | 1.19 | 1.24 | 1.31 | 1.46 |
| CSELB 2003-010-6 |                       |                        |                   |                          |                       | 1                |                         |                          |                                     | 50   | 6     | 10,830 | 1.13 | 1.19 | 1.24 | 1.31 | 1.46 |
| CSELB 2003-0125  | 1.25                  |                        | 45                | 4                        | 8,550                 | 1.38             |                         |                          |                                     | 1.45 | 1.52  | 1.60   | 1.78 |      |      |      |      |
| CSELB 2003-015   | 1.5                   |                        | 45                | 4                        | 8,550                 | 1.64             |                         |                          |                                     | 1.72 | 1.81  | 1.90   | 2.12 |      |      |      |      |
| CSELB 2003-015-6 | 1.5                   |                        | 50                | 6                        | 11,860                | 1.64             |                         |                          |                                     | 1.72 | 1.81  | 1.90   | 2.12 |      |      |      |      |
| CSELB 2003-0175  | 1.75                  |                        | 45                | 4                        | 8,550                 | 1.91             |                         |                          |                                     | 2.00 | 2.10  | 2.21   | 2.47 |      |      |      |      |
| CSELB 2003-020   | 2                     |                        | 45                | 4                        | 8,550                 | 2.17             |                         |                          |                                     | 2.27 | 2.38  | 2.51   | 2.81 |      |      |      |      |
| CSELB 2003-020-6 | 2                     |                        | 50                | 6                        | 11,860                | 2.17             |                         |                          |                                     | 2.27 | 2.38  | 2.51   | 2.81 |      |      |      |      |
| CSELB 2003-0225  | 2.25                  |                        | 45                | 4                        | 8,780                 | 2.43             |                         |                          |                                     | 2.55 | 2.67  | 2.82   | 3.15 |      |      |      |      |
| CSELB 2003-025   | 2.5                   |                        | 45                | 4                        | 8,780                 | 2.69             |                         |                          |                                     | 2.82 | 2.96  | 3.12   | 3.49 |      |      |      |      |
| CSELB 2003-030   | 3                     |                        | 45                | 4                        | 8,780                 | 3.22             |                         |                          |                                     | 3.37 | 3.54  | 3.73   | 4.18 |      |      |      |      |
| CSELB 2003-040   | 4                     |                        | 45                | 4                        | 9,120                 | 4.26             |                         |                          |                                     | 4.47 | 4.70  | 4.95   | 5.55 |      |      |      |      |
| CSELB 2003-050   | 5                     |                        | 45                | 4                        | 10,260                | 5.31             |                         |                          |                                     | 5.57 | 5.85  | 6.17   | 6.92 |      |      |      |      |

Next Page ➔

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Unit (mm)

| Model Number     | Radius of Ball Nose R | Effective Length $l_e$ | Length of Cut $l$ | Neck Diameter $\phi d$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |      |       |      |      |
|------------------|-----------------------|------------------------|-------------------|------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|------|-------|------|------|
|                  |                       |                        |                   |                        |                       |                  |                         |                          | 30°                                 | 1°   | 1°30' | 2°   | 3°   |
| CSELB 2004-005   | RO.2                  | 0.5                    | 0.32              | 0.39                   | 11°                   | 45               | 4                       | 5,470                    | 0.61                                | 0.63 | 0.66  | 0.69 | 0.76 |
| CSELB 2004-0075  |                       | 0.75                   |                   |                        |                       | 45               | 4                       | 5,470                    | 0.87                                | 0.91 | 0.95  | 0.99 | 1.10 |
| CSELB 2004-010   |                       | 1                      |                   |                        |                       | 45               | 4                       | 5,470                    | 1.13                                | 1.18 | 1.24  | 1.30 | 1.44 |
| CSELB 2004-010-6 |                       | 1                      |                   |                        |                       | 50               | 6                       | 7,980                    | 1.13                                | 1.18 | 1.24  | 1.30 | 1.44 |
| CSELB 2004-0125  |                       | 1.25                   |                   |                        |                       | 45               | 4                       | 5,590                    | 1.38                                | 1.44 | 1.51  | 1.59 | 1.76 |
| CSELB 2004-015   |                       | 1.5                    |                   |                        |                       | 45               | 4                       | 5,590                    | 1.64                                | 1.72 | 1.80  | 1.89 | 2.11 |
| CSELB 2004-015-6 |                       | 1.5                    |                   |                        |                       | 50               | 6                       | 8,090                    | 1.64                                | 1.72 | 1.80  | 1.89 | 2.11 |
| CSELB 2004-0175  |                       | 1.75                   |                   |                        |                       | 45               | 4                       | 5,700                    | 1.90                                | 1.99 | 2.09  | 2.19 | 2.45 |
| CSELB 2004-020   |                       | 2                      |                   |                        |                       | 45               | 4                       | 5,700                    | 2.17                                | 2.27 | 2.38  | 2.50 | 2.79 |
| CSELB 2004-020-6 |                       | 2                      |                   |                        |                       | 50               | 6                       | 8,320                    | 2.17                                | 2.27 | 2.38  | 2.50 | 2.79 |
| CSELB 2004-0225  |                       | 2.25                   |                   |                        |                       | 45               | 4                       | 5,930                    | 2.43                                | 2.54 | 2.67  | 2.80 | 3.13 |
| CSELB 2004-025   |                       | 2.5                    |                   |                        |                       | 45               | 4                       | 5,930                    | 2.69                                | 2.82 | 2.95  | 3.11 | 3.48 |
| CSELB 2004-025-6 |                       | 2.5                    |                   |                        |                       | 50               | 6                       | 8,550                    | 2.69                                | 2.82 | 2.95  | 3.11 | 3.48 |
| CSELB 2004-030   |                       | 3                      |                   |                        |                       | 45               | 4                       | 6,270                    | 3.21                                | 3.36 | 3.53  | 3.72 | 4.16 |
| CSELB 2004-030-6 |                       | 3                      |                   |                        |                       | 50               | 6                       | 9,120                    | 3.21                                | 3.36 | 3.53  | 3.72 | 4.16 |
| CSELB 2004-035   |                       | 3.5                    |                   |                        |                       | 45               | 4                       | 6,840                    | 3.74                                | 3.91 | 4.11  | 4.33 | 4.85 |
| CSELB 2004-040   |                       | 4                      |                   |                        |                       | 45               | 4                       | 6,840                    | 4.26                                | 4.46 | 4.69  | 4.94 | 5.53 |
| CSELB 2004-040-6 |                       | 4                      |                   |                        |                       | 50               | 6                       | 9,300                    | 4.26                                | 4.46 | 4.69  | 4.94 | 5.53 |
| CSELB 2004-045   |                       | 4.5                    |                   |                        |                       | 45               | 4                       | 7,180                    | 4.78                                | 5.01 | 5.27  | 5.55 | 6.21 |
| CSELB 2004-050   |                       | 5                      |                   |                        |                       | 45               | 4                       | 7,180                    | 5.31                                | 5.56 | 5.84  | 6.16 | 6.90 |
| CSELB 2004-060   | 6                     | 45                     | 4                 | 8,320                  | 6.35                  | 6.66             | 7.00                    | 7.38                     | 8.27                                |      |       |      |      |
| CSELB 2005-010   | RO.25                 | 1                      | 0.4               | 0.49                   | 11°                   | 45               | 4                       | 5,470                    | 1.13                                | 1.17 | 1.23  | 1.28 | 1.42 |
| CSELB 2005-0125  |                       | 1.25                   |                   |                        |                       | 45               | 4                       | 5,470                    | 1.38                                | 1.43 | 1.50  | 1.57 | 1.74 |
| CSELB 2005-015   |                       | 1.5                    |                   |                        |                       | 45               | 4                       | 5,470                    | 1.64                                | 1.71 | 1.79  | 1.88 | 2.09 |
| CSELB 2005-015-6 |                       | 1.5                    |                   |                        |                       | 50               | 6                       | 7,980                    | 1.64                                | 1.71 | 1.79  | 1.88 | 2.09 |
| CSELB 2005-0175  |                       | 1.75                   |                   |                        |                       | 45               | 4                       | 5,470                    | 1.90                                | 1.98 | 2.08  | 2.18 | 2.43 |
| CSELB 2005-020   |                       | 2                      |                   |                        |                       | 45               | 4                       | 5,470                    | 2.16                                | 2.26 | 2.37  | 2.49 | 2.77 |
| CSELB 2005-020-6 |                       | 2                      |                   |                        |                       | 50               | 6                       | 7,980                    | 2.16                                | 2.26 | 2.37  | 2.49 | 2.77 |
| CSELB 2005-0225  |                       | 2.25                   |                   |                        |                       | 45               | 4                       | 5,470                    | 2.42                                | 2.53 | 2.65  | 2.79 | 3.11 |
| CSELB 2005-025   |                       | 2.5                    |                   |                        |                       | 45               | 4                       | 5,470                    | 2.68                                | 2.81 | 2.94  | 3.10 | 3.45 |
| CSELB 2005-025-6 |                       | 2.5                    |                   |                        |                       | 50               | 6                       | 7,980                    | 2.68                                | 2.81 | 2.94  | 3.10 | 3.45 |
| CSELB 2005-030   |                       | 3                      |                   |                        |                       | 45               | 4                       | 5,470                    | 3.21                                | 3.36 | 3.52  | 3.70 | 4.14 |
| CSELB 2005-030-6 |                       | 3                      |                   |                        |                       | 50               | 6                       | 7,980                    | 3.21                                | 3.36 | 3.52  | 3.70 | 4.14 |
| CSELB 2005-035   |                       | 3.5                    |                   |                        |                       | 45               | 4                       | 5,470                    | 3.73                                | 3.91 | 4.10  | 4.31 | 4.82 |
| CSELB 2005-040   |                       | 4                      |                   |                        |                       | 45               | 4                       | 5,470                    | 4.25                                | 4.46 | 4.68  | 4.92 | 5.51 |
| CSELB 2005-040-6 |                       | 4                      |                   |                        |                       | 50               | 6                       | 7,980                    | 4.25                                | 4.46 | 4.68  | 4.92 | 5.51 |
| CSELB 2005-045   |                       | 4.5                    |                   |                        |                       | 45               | 4                       | 5,590                    | 4.78                                | 5.00 | 5.26  | 5.53 | 6.19 |
| CSELB 2005-050   |                       | 5                      |                   |                        |                       | 45               | 4                       | 5,590                    | 5.30                                | 5.55 | 5.83  | 6.14 | 6.88 |
| CSELB 2005-055   |                       | 5.5                    |                   |                        |                       | 45               | 4                       | 5,700                    | 5.83                                | 6.10 | 6.41  | 6.75 | 7.56 |
| CSELB 2005-060   |                       | 6                      |                   |                        |                       | 45               | 4                       | 5,700                    | 6.35                                | 6.65 | 6.99  | 7.36 | 8.25 |
| CSELB 2005-070   |                       | 7                      |                   |                        |                       | 45               | 4                       | 6,840                    | 7.40                                | 7.75 | 8.14  | 8.58 | 9.62 |
| CSELB 2005-080   | 8                     | 45                     | 4                 | 6,840                  | 8.44                  | 8.85             | 9.30                    | 9.80                     | 10.99                               |      |       |      |      |
| CSELB 2005-090   | 9                     | 45                     | 4                 | 7,980                  | 9.49                  | 9.95             | 10.46                   | 11.02                    | 12.35                               |      |       |      |      |
| CSELB 2005-100   | 10                    | 50                     | 4                 | 8,500                  | 10.54                 | 11.05            | 11.61                   | 12.24                    | 13.72                               |      |       |      |      |

∅3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius

Radius  
Taper Neck  
Radius

Ball / Long  
Shank Ball

Ball  
Long Neck  
Ball

Ball  
Taper Neck  
Ball

Taper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



| Model Number     | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bia | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |       |       |
|------------------|-----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|-------|-------|
|                  |                       |                           |                      |                          |                       |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°    | 3°    |
| CSELB 2006-010   | R0.3                  | 1                         | 0.48                 | 0.59                     | 11°                   | 45               | 4                       | 4,670                    | 1.12                                | 1.17  | 1.22  | 1.27  | 1.40  |
| CSELB 2006-0125  |                       | 1.25                      |                      |                          |                       | 45               | 4                       | 4,220                    | 1.37                                | 1.43  | 1.49  | 1.56  | 1.73  |
| CSELB 2006-015   |                       | 1.5                       |                      |                          |                       | 45               | 4                       | 4,220                    | 1.63                                | 1.70  | 1.78  | 1.87  | 2.07  |
| CSELB 2006-015-6 |                       | 1.5                       |                      |                          |                       | 50               | 6                       | 6,380                    | 1.63                                | 1.70  | 1.78  | 1.87  | 2.07  |
| CSELB 2006-0175  |                       | 1.75                      |                      |                          |                       | 45               | 4                       | 4,220                    | 1.90                                | 1.98  | 2.07  | 2.17  | 2.41  |
| CSELB 2006-020   |                       | 2                         |                      |                          |                       | 45               | 4                       | 4,220                    | 2.16                                | 2.25  | 2.36  | 2.48  | 2.75  |
| CSELB 2006-020-6 |                       | 2                         |                      |                          |                       | 50               | 6                       | 6,380                    | 2.16                                | 2.25  | 2.36  | 2.48  | 2.75  |
| CSELB 2006-0225  |                       | 2.25                      |                      |                          |                       | 45               | 4                       | 4,330                    | 2.42                                | 2.53  | 2.65  | 2.78  | 3.09  |
| CSELB 2006-025   |                       | 2.5                       |                      |                          |                       | 45               | 4                       | 4,330                    | 2.68                                | 2.80  | 2.94  | 3.08  | 3.44  |
| CSELB 2006-025-6 |                       | 2.5                       |                      |                          |                       | 50               | 6                       | 6,380                    | 2.68                                | 2.80  | 2.94  | 3.08  | 3.44  |
| CSELB 2006-030   |                       | 3                         |                      |                          |                       | 45               | 4                       | 4,330                    | 3.21                                | 3.35  | 3.51  | 3.69  | 4.12  |
| CSELB 2006-030-6 |                       | 3                         |                      |                          |                       | 50               | 6                       | 6,500                    | 3.21                                | 3.35  | 3.51  | 3.69  | 4.12  |
| CSELB 2006-035   |                       | 3.5                       |                      |                          |                       | 45               | 4                       | 4,450                    | 3.73                                | 3.90  | 4.09  | 4.30  | 4.81  |
| CSELB 2006-040   |                       | 4                         |                      |                          |                       | 45               | 4                       | 4,450                    | 4.25                                | 4.45  | 4.67  | 4.91  | 5.49  |
| CSELB 2006-040-6 |                       | 4                         |                      |                          |                       | 50               | 6                       | 6,730                    | 4.25                                | 4.45  | 4.67  | 4.91  | 5.49  |
| CSELB 2006-045   |                       | 4.5                       |                      |                          |                       | 45               | 4                       | 4,450                    | 4.78                                | 5.00  | 5.25  | 5.52  | 6.18  |
| CSELB 2006-050   |                       | 5                         |                      |                          |                       | 45               | 4                       | 4,450                    | 5.30                                | 5.55  | 5.83  | 6.13  | 6.86  |
| CSELB 2006-050-6 |                       | 5                         |                      |                          |                       | 50               | 6                       | 6,730                    | 5.30                                | 5.55  | 5.83  | 6.13  | 6.86  |
| CSELB 2006-055   |                       | 5.5                       |                      |                          |                       | 45               | 4                       | 4,450                    | 5.82                                | 6.10  | 6.40  | 6.74  | 7.54  |
| CSELB 2006-060   |                       | 6                         |                      |                          |                       | 45               | 4                       | 4,450                    | 6.35                                | 6.65  | 6.98  | 7.35  | 8.23  |
| CSELB 2006-060-6 | 6                     | 50                        | 6                    | 6,730                    | 6.35                  | 6.65             | 6.98                    | 7.35                     | 8.23                                |       |       |       |       |
| CSELB 2006-065   | 6.5                   | 45                        | 4                    | 5,020                    | 6.87                  | 7.20             | 7.56                    | 7.96                     | 8.91                                |       |       |       |       |
| CSELB 2006-070   | 7                     | 45                        | 4                    | 5,020                    | 7.39                  | 7.75             | 8.14                    | 8.57                     | 9.60                                |       |       |       |       |
| CSELB 2006-080   | 8                     | 45                        | 4                    | 5,930                    | 8.44                  | 8.85             | 9.29                    | 9.79                     | 10.97                               |       |       |       |       |
| CSELB 2006-080-6 | 8                     | 50                        | 6                    | 8,550                    | 8.44                  | 8.85             | 9.29                    | 9.79                     | 10.97                               |       |       |       |       |
| CSELB 2006-090   | 9                     | 45                        | 4                    | 6,270                    | 9.49                  | 9.94             | 10.45                   | 11.01                    | 12.34                               |       |       |       |       |
| CSELB 2006-100   | 10                    | 50                        | 4                    | 6,040                    | 10.53                 | 11.04            | 11.60                   | 12.23                    | 13.71                               |       |       |       |       |
| CSELB 2006-100-6 | 10                    | 50                        | 6                    | 9,120                    | 10.53                 | 11.04            | 11.60                   | 12.23                    | 13.71                               |       |       |       |       |
| CSELB 2006-120   | 12                    | 50                        | 4                    | 6,840                    | 12.63                 | 13.24            | 13.92                   | 14.66                    | 16.44                               |       |       |       |       |
| CSELB 2007-020   | R0.35                 | 2                         | 0.56                 | 0.69                     | 11°                   | 45               | 4                       | 4,220                    | 2.16                                | 2.25  | 2.35  | 2.46  | 2.73  |
| CSELB 2007-040   |                       | 4                         |                      |                          |                       | 45               | 4                       | 4,450                    | 4.25                                | 4.45  | 4.66  | 4.90  | 5.47  |
| CSELB 2007-060   |                       | 6                         |                      |                          |                       | 45               | 4                       | 4,450                    | 6.34                                | 6.64  | 6.97  | 7.34  | 8.21  |
| CSELB 2007-080   |                       | 8                         |                      |                          |                       | 45               | 4                       | 4,450                    | 8.44                                | 8.84  | 9.28  | 9.78  | 10.95 |
| CSELB 2008-020   | R0.4                  | 2                         | 0.64                 | 0.79                     | 11°                   | 45               | 4                       | 4,220                    | 2.15                                | 2.24  | 2.34  | 2.45  | 2.72  |
| CSELB 2008-020-6 |                       | 2                         |                      |                          |                       | 50               | 6                       | 6,380                    | 2.15                                | 2.24  | 2.34  | 2.45  | 2.72  |
| CSELB 2008-030   |                       | 3                         |                      |                          |                       | 45               | 4                       | 4,450                    | 3.20                                | 3.34  | 3.50  | 3.67  | 4.09  |
| CSELB 2008-030-6 |                       | 3                         |                      |                          |                       | 50               | 6                       | 6,730                    | 3.20                                | 3.34  | 3.50  | 3.67  | 4.09  |
| CSELB 2008-040   |                       | 4                         |                      |                          |                       | 45               | 4                       | 4,450                    | 4.25                                | 4.44  | 4.65  | 4.89  | 5.45  |
| CSELB 2008-040-6 |                       | 4                         |                      |                          |                       | 50               | 6                       | 6,730                    | 4.25                                | 4.44  | 4.65  | 4.89  | 5.45  |
| CSELB 2008-050   |                       | 5                         |                      |                          |                       | 45               | 4                       | 4,450                    | 5.29                                | 5.54  | 5.81  | 6.11  | 6.82  |
| CSELB 2008-060   |                       | 6                         |                      |                          |                       | 45               | 4                       | 4,450                    | 6.34                                | 6.64  | 6.97  | 7.33  | 8.19  |
| CSELB 2008-060-6 |                       | 6                         |                      |                          |                       | 50               | 6                       | 6,730                    | 6.34                                | 6.64  | 6.97  | 7.33  | 8.19  |
| CSELB 2008-070   |                       | 7                         |                      |                          |                       | 45               | 4                       | 4,450                    | 7.39                                | 7.74  | 8.12  | 8.55  | 9.56  |
| CSELB 2008-080   |                       | 8                         |                      |                          |                       | 45               | 4                       | 4,450                    | 8.44                                | 8.84  | 9.28  | 9.77  | 10.93 |
| CSELB 2008-080-6 |                       | 8                         |                      |                          |                       | 50               | 6                       | 6,730                    | 8.44                                | 8.84  | 9.28  | 9.77  | 10.93 |
| CSELB 2008-090   |                       | 9                         |                      |                          |                       | 45               | 4                       | 5,930                    | 9.48                                | 9.93  | 10.43 | 10.99 | 12.30 |
| CSELB 2008-100   |                       | 10                        |                      |                          |                       | 50               | 4                       | 5,930                    | 10.53                               | 11.03 | 11.59 | 12.21 | 13.67 |
| CSELB 2008-100-6 |                       | 10                        |                      |                          |                       | 50               | 6                       | 8,550                    | 10.53                               | 11.03 | 11.59 | 12.21 | 13.67 |
| CSELB 2008-120   |                       | 12                        |                      |                          |                       | 45               | 4                       | 7,300                    | 12.62                               | 13.23 | 13.90 | 14.64 | 16.41 |
| CSELB 2008-160   |                       | 16                        |                      |                          |                       | 50               | 4                       | 9,990                    | 16.81                               | 17.62 | 18.52 | 19.52 | 21.88 |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Unit (mm)

| Model Number     | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |       |       |      |      |      |      |
|------------------|-----------------------|------------------------|-------------------|------------------------|---------------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|-------|-------|------|------|------|------|
|                  |                       |                        |                   |                        |                           |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°    | 3°    |      |      |      |      |
| CSELB 2009-020   | RO.45                 | 2                      | 0.72              | 0.89                   | 11°                       | 45               | 4                       | 4,220                    | 2.15                                | 2.24  | 2.34  | 2.44  | 2.70  |      |      |      |      |
| CSELB 2009-040   |                       | 4                      |                   |                        |                           | 45               | 4                       | 4,450                    | 4.25                                | 4.44  | 4.65  | 4.88  | 5.44  |      |      |      |      |
| CSELB 2009-060   |                       | 6                      |                   |                        |                           | 45               | 4                       | 4,450                    | 6.34                                | 6.63  | 6.96  | 7.32  | 8.17  |      |      |      |      |
| CSELB 2009-080   |                       | 8                      |                   |                        |                           | 45               | 4                       | 4,450                    | 8.43                                | 8.83  | 9.27  | 9.76  | 10.91 |      |      |      |      |
| CSELB 2009-100   |                       | 10                     |                   |                        |                           | 45               | 4                       | 5,930                    | 10.53                               | 11.03 | 11.58 | 12.19 | 13.65 |      |      |      |      |
| CSELB 2009-120   |                       | 12                     |                   |                        |                           | 45               | 4                       | 7,300                    | 12.62                               | 13.23 | 13.89 | 14.63 | 16.39 |      |      |      |      |
| CSELB 2009-140   |                       | 14                     |                   |                        |                           | 50               | 4                       | 8,460                    | 14.72                               | 15.42 | 16.20 | 17.07 | 19.13 |      |      |      |      |
| CSELB 2009-160   |                       | 16                     |                   |                        |                           | 50               | 4                       | 9,990                    | 16.81                               | 17.62 | 18.51 | 19.51 | 21.87 |      |      |      |      |
| CSELB 2009-180   |                       | 18                     |                   |                        |                           | 55               | 4                       | 9,990                    | 18.90                               | 19.82 | 20.83 | 21.95 | 24.60 |      |      |      |      |
| CSELB 2010-020   | RO.5                  | 2                      | 0.8               | 0.98                   | 11°                       | 45               | 4                       | 3,530                    | 2.17                                | 2.25  | 2.35  | 2.45  | 2.70  |      |      |      |      |
| CSELB 2010-025   |                       | 2.5                    |                   |                        |                           | 45               | 4                       | 3,530                    | 2.69                                | 2.80  | 2.92  | 3.06  | 3.39  |      |      |      |      |
| CSELB 2010-030   |                       | 3                      |                   |                        |                           | 45               | 4                       | 3,530                    | 3.21                                | 3.35  | 3.50  | 3.67  | 4.07  |      |      |      |      |
| CSELB 2010-030-6 |                       | 3                      |                   |                        |                           | 50               | 6                       | 5,590                    | 3.21                                | 3.35  | 3.50  | 3.67  | 4.07  |      |      |      |      |
| CSELB 2010-040   |                       | 4                      |                   |                        |                           | 45               | 4                       | 3,990                    | 4.26                                | 4.45  | 4.66  | 4.89  | 5.44  |      |      |      |      |
| CSELB 2010-040-6 |                       | 4                      |                   |                        |                           | 50               | 6                       | 6,160                    | 4.26                                | 4.45  | 4.66  | 4.89  | 5.44  |      |      |      |      |
| CSELB 2010-050   |                       | 5                      |                   |                        |                           | 45               | 4                       | 3,990                    | 5.31                                | 5.55  | 5.81  | 6.11  | 6.81  |      |      |      |      |
| CSELB 2010-050-6 |                       | 5                      |                   |                        |                           | 50               | 6                       | 6,160                    | 5.31                                | 5.55  | 5.81  | 6.11  | 6.81  |      |      |      |      |
| CSELB 2010-060   |                       | 6                      |                   |                        |                           | 45               | 4                       | 4,330                    | 6.35                                | 6.65  | 6.97  | 7.33  | 8.18  |      |      |      |      |
| CSELB 2010-060-6 |                       | 6                      |                   |                        |                           | 50               | 6                       | 6,500                    | 6.35                                | 6.65  | 6.97  | 7.33  | 8.18  |      |      |      |      |
| CSELB 2010-070   |                       | 7                      |                   |                        |                           | 45               | 4                       | 4,330                    | 7.40                                | 7.74  | 8.12  | 8.55  | 9.55  |      |      |      |      |
| CSELB 2010-070-6 |                       | 7                      |                   |                        |                           | 50               | 6                       | 6,500                    | 7.40                                | 7.74  | 8.12  | 8.55  | 9.55  |      |      |      |      |
| CSELB 2010-080   |                       | 8                      |                   |                        |                           | 45               | 4                       | 4,330                    | 8.45                                | 8.84  | 9.28  | 9.76  | 10.92 |      |      |      |      |
| CSELB 2010-080-6 |                       | 8                      |                   |                        |                           | 50               | 6                       | 6,500                    | 8.45                                | 8.84  | 9.28  | 9.76  | 10.92 |      |      |      |      |
| CSELB 2010-090   |                       | 9                      |                   |                        |                           | 45               | 4                       | 4,330                    | 9.49                                | 9.94  | 10.44 | 10.98 | 12.29 |      |      |      |      |
| CSELB 2010-100   |                       | 10                     |                   |                        |                           | 45               | 4                       | 4,330                    | 10.54                               | 11.04 | 11.59 | 12.20 | 13.65 |      |      |      |      |
| CSELB 2010-100-6 |                       | 10                     |                   |                        |                           | 50               | 6                       | 6,500                    | 10.54                               | 11.04 | 11.59 | 12.20 | 13.65 |      |      |      |      |
| CSELB 2010-120   |                       | 12                     |                   |                        |                           | 45               | 4                       | 4,330                    | 12.64                               | 13.24 | 13.90 | 14.64 | 16.39 |      |      |      |      |
| CSELB 2010-120-6 |                       | 12                     |                   |                        |                           | 50               | 6                       | 6,500                    | 12.64                               | 13.24 | 13.90 | 14.64 | 16.39 |      |      |      |      |
| CSELB 2010-140   |                       | 14                     |                   |                        |                           | 50               | 4                       | 5,020                    | 14.73                               | 15.43 | 16.21 | 17.08 | 19.13 |      |      |      |      |
| CSELB 2010-140-6 |                       | 14                     |                   |                        |                           | 60               | 6                       | 7,070                    | 14.73                               | 15.43 | 16.21 | 17.08 | 19.13 |      |      |      |      |
| CSELB 2010-160   |                       | 16                     |                   |                        |                           | 50               | 4                       | 5,930                    | 16.82                               | 17.63 | 18.53 | 19.52 | 21.87 |      |      |      |      |
| CSELB 2010-160-6 |                       | 16                     |                   |                        |                           | 60               | 6                       | 8,550                    | 16.82                               | 17.63 | 18.53 | 19.52 | 21.87 |      |      |      |      |
| CSELB 2010-180   |                       | 18                     |                   |                        |                           | 55               | 4                       | 5,930                    | 18.92                               | 19.83 | 20.84 | 21.95 | 24.61 |      |      |      |      |
| CSELB 2010-200   |                       | 20                     |                   |                        |                           | 55               | 4                       | 7,180                    | 21.01                               | 22.03 | 23.15 | 24.39 | 27.35 |      |      |      |      |
| CSELB 2010-200-6 |                       | 20                     |                   |                        |                           | 70               | 6                       | 10,150                   | 21.01                               | 22.03 | 23.15 | 24.39 | 27.35 |      |      |      |      |
| CSELB 2010-220-6 |                       | 22                     |                   |                        |                           | 70               | 6                       | 10,600                   | 23.11                               | 24.22 | 25.46 | 26.83 | 30.08 |      |      |      |      |
| CSELB 2012-025   |                       | RO.6                   |                   |                        |                           | 2.5              | 0.96                    | 1.19                     | 11°                                 | 45    | 4     | 5,360 | 2.58  | 2.68 | 2.80 | 2.92 | 3.22 |
| CSELB 2012-040   |                       |                        |                   |                        |                           | 4                |                         |                          |                                     | 45    | 4     | 5,360 | 4.15  | 4.33 | 4.53 | 4.75 | 5.27 |
| CSELB 2012-060   |                       |                        |                   |                        |                           | 6                |                         |                          |                                     | 45    | 4     | 5,810 | 6.25  | 6.53 | 6.84 | 7.19 | 8.01 |
| CSELB 2012-060-6 | 6                     |                        | 50                | 6                      | 8,270                     | 6.25             |                         |                          |                                     | 6.53  | 6.84  | 7.19  | 8.01  |      |      |      |      |
| CSELB 2012-080   | 8                     |                        | 45                | 4                      | 5,810                     | 8.34             |                         |                          |                                     | 8.73  | 9.15  | 9.63  | 10.75 |      |      |      |      |
| CSELB 2012-080-6 | 8                     |                        | 50                | 6                      | 8,270                     | 8.34             |                         |                          |                                     | 8.73  | 9.15  | 9.63  | 10.75 |      |      |      |      |
| CSELB 2012-100   | 10                    |                        | 45                | 4                      | 5,810                     | 10.44            |                         |                          |                                     | 10.92 | 11.46 | 12.06 | 13.49 |      |      |      |      |
| CSELB 2012-100-6 | 10                    |                        | 50                | 6                      | 8,270                     | 10.44            |                         |                          |                                     | 10.92 | 11.46 | 12.06 | 13.49 |      |      |      |      |
| CSELB 2012-120   | 12                    |                        | 45                | 4                      | 5,810                     | 12.53            |                         |                          |                                     | 13.12 | 13.78 | 14.50 | 16.23 |      |      |      |      |
| CSELB 2012-120-6 | 12                    |                        | 50                | 6                      | 8,270                     | 12.53            |                         |                          |                                     | 13.12 | 13.78 | 14.50 | 16.23 |      |      |      |      |
| CSELB 2012-140   | 14                    |                        | 50                | 4                      | 6,270                     | 14.62            |                         |                          |                                     | 15.32 | 16.09 | 16.94 | 18.96 |      |      |      |      |
| CSELB 2012-160   | 16                    |                        | 50                | 4                      | 6,840                     | 16.72            |                         |                          |                                     | 17.52 | 18.40 | 19.38 | 21.70 |      |      |      |      |
| CSELB 2012-160-6 | 16                    |                        | 60                | 6                      | 9,410                     | 16.72            |                         |                          |                                     | 17.52 | 18.40 | 19.38 | 21.70 |      |      |      |      |
| CSELB 2012-180   | 18                    |                        | 55                | 4                      | 7,410                     | 18.81            |                         |                          |                                     | 19.71 | 20.71 | 21.82 | 24.44 |      |      |      |      |
| CSELB 2012-200   | 20                    |                        | 60                | 4                      | 7,410                     | 20.91            |                         |                          |                                     | 21.91 | 23.02 | 24.25 | 27.18 |      |      |      |      |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball / Long  
Shank Ball  
Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

| Model Number     | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_i$ | Shank Taper Angle Bia | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |       |                 |                 |
|------------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|-------|-----------------|-----------------|
|                  |                       |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°    | 1°30' | 2°              | 3°              |
| CSELB 2014-060   | RO.7                  | 6                      | 1.12              | 1.37                     | 11°                   | 45               | 4                       | 5,020                    | 6.30                                | 6.58  | 6.89  | 7.23            | 8.04            |
| CSELB 2014-080   |                       | 8                      |                   |                          |                       | 45               | 4                       | 5,020                    | 8.39                                | 8.77  | 9.20  | 9.67            | 10.78           |
| CSELB 2014-120   |                       | 12                     |                   |                          |                       | 45               | 4                       | 5,020                    | 12.58                               | 13.17 | 13.82 | 14.54           | 16.26           |
| CSELB 2014-160   |                       | 16                     |                   |                          |                       | 50               | 4                       | 5,020                    | 16.77                               | 17.56 | 18.44 | 19.42           | 21.74           |
| CSELB 2015-030   | RO.75                 | 3                      | 1.2               | 1.47                     | 11°                   | 45               | 4                       | 4,100                    | 3.15                                | 3.28  | 3.41  | 3.56            | 3.92            |
| CSELB 2015-040   |                       | 4                      |                   |                          |                       | 45               | 4                       | 4,100                    | 4.20                                | 4.37  | 4.57  | 4.78            | 5.29            |
| CSELB 2015-060   |                       | 6                      |                   |                          |                       | 45               | 4                       | 4,100                    | 6.29                                | 6.57  | 6.88  | 7.22            | 8.03            |
| CSELB 2015-060-6 |                       | 6                      |                   |                          |                       | 50               | 6                       | 6,610                    | 6.29                                | 6.57  | 6.88  | 7.22            | 8.03            |
| CSELB 2015-080   |                       | 8                      |                   |                          |                       | 45               | 4                       | 4,330                    | 8.39                                | 8.77  | 9.19  | 9.66            | 10.77           |
| CSELB 2015-080-6 |                       | 8                      |                   |                          |                       | 50               | 6                       | 6,610                    | 8.39                                | 8.77  | 9.19  | 9.66            | 10.77           |
| CSELB 2015-100   |                       | 10                     |                   |                          |                       | 45               | 4                       | 4,670                    | 10.48                               | 10.97 | 11.50 | 12.09           | 13.50           |
| CSELB 2015-100-6 |                       | 10                     |                   |                          |                       | 50               | 6                       | 6,610                    | 10.48                               | 10.97 | 11.50 | 12.09           | 13.50           |
| CSELB 2015-120   |                       | 12                     |                   |                          |                       | 45               | 4                       | 5,020                    | 12.58                               | 13.16 | 13.81 | 14.53           | 16.24           |
| CSELB 2015-120-6 |                       | 12                     |                   |                          |                       | 50               | 6                       | 7,520                    | 12.58                               | 13.16 | 13.81 | 14.53           | 16.24           |
| CSELB 2015-140   |                       | 14                     |                   |                          |                       | 50               | 4                       | 5,020                    | 14.67                               | 15.36 | 16.12 | 16.97           | 18.98           |
| CSELB 2015-160   |                       | 16                     |                   |                          |                       | 50               | 4                       | 5,020                    | 16.76                               | 17.56 | 18.43 | 19.41           | 21.72           |
| CSELB 2015-160-6 |                       | 16                     |                   |                          |                       | 60               | 6                       | 7,520                    | 16.76                               | 17.56 | 18.43 | 19.41           | 21.72           |
| CSELB 2015-180   |                       | 18                     |                   |                          |                       | 55               | 4                       | 5,020                    | 18.86                               | 19.76 | 20.75 | 21.85           | 24.46           |
| CSELB 2015-200   |                       | 20                     |                   |                          |                       | 55               | 4                       | 5,020                    | 20.95                               | 21.95 | 23.06 | 24.28           | No Interference |
| CSELB 2015-200-6 |                       | 20                     |                   |                          |                       | 60               | 6                       | 7,520                    | 20.95                               | 21.95 | 23.06 | 24.28           | 27.19           |
| CSELB 2015-220   | 22                    | 55                     | 4                 | 5,020                    | 23.05                 | 24.15            | 25.37                   | 26.72                    | No Interference                     |       |       |                 |                 |
| CSELB 2015-250   | 25                    | 65                     | 4                 | 7,000                    | 26.19                 | 27.45            | 28.84                   | 30.38                    | No Interference                     |       |       |                 |                 |
| CSELB 2015-300   | 30                    | 70                     | 4                 | 8,210                    | 31.42                 | 32.94            | 34.61                   | 36.47                    | No Interference                     |       |       |                 |                 |
| CSELB 2016-040   | RO.8                  | 4                      | 1.28              | 1.58                     | 11°                   | 45               | 4                       | 5,700                    | 4.17                                | 4.34  | 4.53  | 4.74            | 5.24            |
| CSELB 2016-080   |                       | 8                      |                   |                          |                       | 45               | 4                       | 5,810                    | 8.36                                | 8.74  | 9.15  | 9.61            | 10.71           |
| CSELB 2016-120   |                       | 12                     |                   |                          |                       | 45               | 4                       | 5,810                    | 12.55                               | 13.13 | 13.77 | 14.49           | 16.19           |
| CSELB 2016-160   |                       | 16                     |                   |                          |                       | 50               | 4                       | 5,810                    | 16.74                               | 17.53 | 18.40 | 19.37           | 21.66           |
| CSELB 2016-200   |                       | 20                     |                   |                          |                       | 55               | 4                       | 5,810                    | 20.92                               | 21.92 | 23.02 | 24.24           | No Interference |
| CSELB 2018-040   | RO.9                  | 4                      | 1.44              | 1.78                     | 11°                   | 45               | 4                       | 4,750                    | 4.17                                | 4.33  | 4.51  | 4.72            | 5.20            |
| CSELB 2018-060   |                       | 6                      |                   |                          |                       | 45               | 4                       | 4,750                    | 6.26                                | 6.53  | 6.83  | 7.15            | 7.94            |
| CSELB 2018-080   |                       | 8                      |                   |                          |                       | 45               | 4                       | 5,020                    | 8.35                                | 8.73  | 9.14  | 9.59            | 10.68           |
| CSELB 2018-100   |                       | 10                     |                   |                          |                       | 45               | 4                       | 5,020                    | 10.45                               | 10.92 | 11.45 | 12.03           | 13.41           |
| CSELB 2018-120   |                       | 12                     |                   |                          |                       | 45               | 4                       | 5,020                    | 12.54                               | 13.12 | 13.76 | 14.47           | 16.15           |
| CSELB 2018-160   |                       | 16                     |                   |                          |                       | 50               | 4                       | 5,020                    | 16.73                               | 17.52 | 18.38 | 19.34           | 21.63           |
| CSELB 2018-180   |                       | 18                     |                   |                          |                       | 55               | 4                       | 5,020                    | 18.82                               | 19.71 | 20.69 | 21.78           | No Interference |
| CSELB 2018-200   |                       | 20                     |                   |                          |                       | 55               | 4                       | 5,020                    | 20.92                               | 21.91 | 23.00 | 24.22           | No Interference |
| CSELB 2018-220   |                       | 22                     |                   |                          |                       | 60               | 4                       | 6,870                    | 23.01                               | 24.11 | 25.32 | 26.66           | No Interference |
| CSELB 2018-250   |                       | 25                     |                   |                          |                       | 65               | 4                       | 7,000                    | 26.15                               | 27.40 | 28.78 | 30.32           | No Interference |
| CSELB 2018-300   |                       | 30                     |                   |                          |                       | 70               | 4                       | 7,930                    | 31.39                               | 32.90 | 34.56 | No Interference | No Interference |

Unit (mm)

| Model Number     | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |       |       |       |       |
|------------------|-----------------------|------------------------|-------------------|------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-------|-------|-------|-------|
|                  |                       |                        |                   |                        |                       |                  |                         |                          | 30°                                 | 1°              | 1°30'           | 2°              | 3°              |       |       |       |       |
| CSELB 2020-030   | R1                    | 3                      | 1.6               | 1.98                   | 11°                   | 45               | 4                       | 3,530                    | 3.11                                | 3.22            | 3.34            | 3.48            | 3.79            |       |       |       |       |
| CSELB 2020-040   |                       | 4                      |                   |                        |                       | 45               | 4                       | 3,530                    | 4.16                                | 4.32            | 4.50            | 4.70            | 5.16            |       |       |       |       |
| CSELB 2020-040-6 |                       | 4                      |                   |                        |                       | 50               | 6                       | 5,590                    | 4.16                                | 4.32            | 4.50            | 4.70            | 5.16            |       |       |       |       |
| CSELB 2020-060   |                       | 6                      |                   |                        |                       | 45               | 4                       | 3,990                    | 6.26                                | 6.52            | 6.81            | 7.13            | 7.90            |       |       |       |       |
| CSELB 2020-060-6 |                       | 6                      |                   |                        |                       | 50               | 6                       | 6,040                    | 6.26                                | 6.52            | 6.81            | 7.13            | 7.90            |       |       |       |       |
| CSELB 2020-080   |                       | 8                      |                   |                        |                       | 45               | 4                       | 4,330                    | 8.35                                | 8.72            | 9.12            | 9.57            | 10.64           |       |       |       |       |
| CSELB 2020-080-6 |                       | 8                      |                   |                        |                       | 50               | 6                       | 6,500                    | 8.35                                | 8.72            | 9.12            | 9.57            | 10.64           |       |       |       |       |
| CSELB 2020-100   |                       | 10                     |                   |                        |                       | 45               | 4                       | 4,330                    | 10.44                               | 10.91           | 11.43           | 12.01           | 13.38           |       |       |       |       |
| CSELB 2020-100-6 |                       | 10                     |                   |                        |                       | 50               | 6                       | 6,500                    | 10.44                               | 10.91           | 11.43           | 12.01           | 13.38           |       |       |       |       |
| CSELB 2020-120   |                       | 12                     |                   |                        |                       | 45               | 4                       | 4,330                    | 12.54                               | 13.11           | 13.74           | 14.45           | 16.12           |       |       |       |       |
| CSELB 2020-120-6 |                       | 12                     |                   |                        |                       | 50               | 6                       | 6,500                    | 12.54                               | 13.11           | 13.74           | 14.45           | 16.12           |       |       |       |       |
| CSELB 2020-130   |                       | 13                     |                   |                        |                       | 45               | 4                       | 4,330                    | 13.59                               | 14.21           | 14.90           | 15.67           | 17.49           |       |       |       |       |
| CSELB 2020-140   |                       | 14                     |                   |                        |                       | 50               | 4                       | 4,330                    | 14.63                               | 15.31           | 16.06           | 16.89           | 18.85           |       |       |       |       |
| CSELB 2020-160   |                       | 16                     |                   |                        |                       | 50               | 4                       | 4,330                    | 16.73                               | 17.51           | 18.37           | 19.32           | No Interference |       |       |       |       |
| CSELB 2020-160-6 |                       | 16                     |                   |                        |                       | 60               | 6                       | 6,500                    | 16.73                               | 17.51           | 18.37           | 19.32           | 21.59           |       |       |       |       |
| CSELB 2020-180   |                       | 18                     |                   |                        |                       | 55               | 4                       | 4,330                    | 18.82                               | 19.70           | 20.68           | 21.76           | No Interference |       |       |       |       |
| CSELB 2020-200   |                       | 20                     |                   |                        |                       | 55               | 4                       | 4,330                    | 20.91                               | 21.90           | 22.99           | 24.20           | No Interference |       |       |       |       |
| CSELB 2020-200-6 |                       | 20                     |                   |                        |                       | 70               | 6                       | 6,500                    | 20.91                               | 21.90           | 22.99           | 24.20           | 27.07           |       |       |       |       |
| CSELB 2020-220   |                       | 22                     |                   |                        |                       | 60               | 4                       | 5,930                    | 23.01                               | 24.10           | 25.30           | 26.64           | No Interference |       |       |       |       |
| CSELB 2020-250   |                       | 25                     |                   |                        |                       | 65               | 4                       | 6,040                    | 26.15                               | 27.39           | 28.77           | No Interference | No Interference |       |       |       |       |
| CSELB 2020-250-6 |                       | 25                     |                   |                        |                       | 80               | 6                       | 8,550                    | 26.15                               | 27.39           | 28.77           | 30.29           | 33.92           |       |       |       |       |
| CSELB 2020-270   |                       | 27                     |                   |                        |                       | 65               | 4                       | 6,040                    | 28.24                               | 29.59           | 31.08           | No Interference | No Interference |       |       |       |       |
| CSELB 2020-300   |                       | 30                     |                   |                        |                       | 70               | 4                       | 6,840                    | 31.38                               | 32.89           | 34.55           | No Interference | No Interference |       |       |       |       |
| CSELB 2020-300-6 |                       | 30                     |                   |                        |                       | 80               | 6                       | 9,690                    | 31.38                               | 32.89           | 34.55           | 36.39           | No Interference |       |       |       |       |
| CSELB 2020-320   |                       | 32                     |                   |                        |                       | 70               | 4                       | 6,840                    | 33.48                               | 35.08           | 36.86           | No Interference | No Interference |       |       |       |       |
| CSELB 2020-350   |                       | 35                     |                   |                        |                       | 80               | 4                       | 9,350                    | 36.62                               | 38.38           | No Interference | No Interference | No Interference |       |       |       |       |
| CSELB 2020-350-6 |                       | 35                     |                   |                        |                       | 80               | 6                       | 12,650                   | 36.62                               | 38.38           | 40.32           | 42.48           | No Interference |       |       |       |       |
| CSELB 2020-400   |                       | 40                     |                   |                        |                       | 80               | 4                       | 9,350                    | 41.85                               | 43.87           | No Interference | No Interference | No Interference |       |       |       |       |
| CSELB 2020-400-6 |                       | 40                     |                   |                        |                       | 90               | 6                       | 12,650                   | 41.85                               | 43.87           | 46.10           | 48.58           | No Interference |       |       |       |       |
| CSELB 2025-060   |                       | R1.25                  |                   |                        |                       | 6                | 2                       | 2.45                     | 11°                                 | 45              | 4               | 4,670           | 6.33            | 6.58  | 6.86  | 7.17  | 7.92  |
| CSELB 2025-080   |                       |                        |                   |                        |                       | 8                |                         |                          |                                     | 45              | 4               | 4,700           | 8.42            | 8.78  | 9.17  | 9.61  | 10.66 |
| CSELB 2025-100   |                       |                        |                   |                        |                       | 10               |                         |                          |                                     | 45              | 4               | 4,900           | 10.51           | 10.97 | 11.48 | 12.05 | 13.39 |
| CSELB 2025-150   | 15                    |                        | 50                | 4                      | 5,810                 | 15.75            |                         |                          |                                     | 16.47           | 17.26           | 18.14           | No Interference |       |       |       |       |
| CSELB 2025-200   | 20                    |                        | 55                | 4                      | 6,840                 | 20.98            |                         |                          |                                     | 21.96           | 23.04           | No Interference | No Interference |       |       |       |       |
| CSELB 2025-250   | 25                    |                        | 65                | 4                      | 7,300                 | 26.22            |                         |                          |                                     | 27.45           | 28.82           | No Interference | No Interference |       |       |       |       |
| CSELB 2025-300   | 30                    |                        | 70                | 4                      | 7,300                 | 31.45            |                         |                          |                                     | 32.95           | No Interference | No Interference | No Interference |       |       |       |       |
| CSELB 2025-350   | 35                    |                        | 70                | 4                      | 8,440                 | 36.69            |                         |                          |                                     | 38.44           | No Interference | No Interference | No Interference |       |       |       |       |
| CSELB 2030-060   | R1.5                  | 6                      | 2.4               | 2.95                   | 11°                   | 60               | 6                       | 4,330                    | 6.31                                | 6.55            | 6.82            | 7.12            | 7.83            |       |       |       |       |
| CSELB 2030-060-3 |                       | 6                      |                   |                        | 60                    | 3                | 3,990                   | No Interference          | No Interference                     | No Interference | No Interference | No Interference |                 |       |       |       |       |
| CSELB 2030-060-4 |                       | 6                      |                   |                        | 60                    | 4                | 3,990                   | 6.31                     | 6.55                                | 6.82            | 7.12            | 7.83            |                 |       |       |       |       |
| CSELB 2030-080   |                       | 8                      |                   |                        | 60                    | 6                | 4,330                   | 8.41                     | 8.75                                | 9.13            | 9.56            | 10.57           |                 |       |       |       |       |
| CSELB 2030-100   |                       | 10                     |                   |                        | 60                    | 6                | 5,020                   | 10.50                    | 10.95                               | 11.44           | 12.00           | 13.30           |                 |       |       |       |       |
| CSELB 2030-120   |                       | 12                     |                   |                        | 60                    | 6                | 5,240                   | 12.60                    | 13.15                               | 13.76           | 14.43           | 16.04           |                 |       |       |       |       |
| CSELB 2030-140   |                       | 14                     |                   |                        | 60                    | 6                | 5,810                   | 14.69                    | 15.34                               | 16.07           | 16.87           | 18.78           |                 |       |       |       |       |
| CSELB 2030-150   |                       | 15                     |                   |                        | 60                    | 6                | 5,700                   | 15.74                    | 16.44                               | 17.22           | 18.09           | 20.15           |                 |       |       |       |       |
| CSELB 2030-160   |                       | 16                     |                   |                        | 60                    | 6                | 5,810                   | 16.78                    | 17.54                               | 18.38           | 19.31           | 21.52           |                 |       |       |       |       |
| CSELB 2030-180   |                       | 18                     |                   |                        | 60                    | 6                | 5,810                   | 18.88                    | 19.74                               | 20.69           | 21.75           | 24.26           |                 |       |       |       |       |
| CSELB 2030-200   |                       | 20                     |                   |                        | 70                    | 6                | 5,590                   | 20.97                    | 21.94                               | 23.00           | 24.19           | 27.00           |                 |       |       |       |       |
| CSELB 2030-220   |                       | 22                     |                   |                        | 70                    | 6                | 5,590                   | 23.07                    | 24.13                               | 25.31           | 26.62           | 29.73           |                 |       |       |       |       |
| CSELB 2030-250   |                       | 25                     |                   |                        | 70                    | 6                | 5,590                   | 26.21                    | 27.43                               | 28.78           | 30.28           | No Interference |                 |       |       |       |       |
| CSELB 2030-270   |                       | 27                     |                   |                        | 70                    | 6                | 5,590                   | 28.30                    | 29.63                               | 31.09           | 32.72           | No Interference |                 |       |       |       |       |
| CSELB 2030-300   |                       | 30                     |                   |                        | 70                    | 6                | 6,380                   | 31.44                    | 32.92                               | 34.56           | 36.38           | No Interference |                 |       |       |       |       |
| CSELB 2030-320   |                       | 32                     |                   |                        | 80                    | 6                | 8,090                   | 33.54                    | 35.12                               | 36.87           | 38.81           | No Interference |                 |       |       |       |       |
| CSELB 2030-350   |                       | 35                     |                   |                        | 80                    | 6                | 8,090                   | 36.68                    | 38.42                               | 40.34           | 42.47           | No Interference |                 |       |       |       |       |
| CSELB 2030-400   |                       | 40                     |                   |                        | 80                    | 6                | 10,030                  | 41.91                    | 43.91                               | 46.12           | No Interference | No Interference |                 |       |       |       |       |

Ø3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

| Model Number     | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bia | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |                 |                 |                 |
|------------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                  |                       |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°              | 1°30'           | 2°              | 3°              |                 |                 |                 |
| CSELB 2035-100   | R1.75                 | 10                     | 2.8               | 3.45                     | 11°                   | 60               | 6                       | 6,380                    | 10.49                               | 10.93           | 11.41           | 11.94           | 13.21           |                 |                 |                 |
| CSELB 2035-150   |                       | 15                     |                   |                          |                       | 60               | 6                       | 6,380                    | 15.72                               | 16.42           | 17.19           | 18.04           | 20.06           |                 |                 |                 |
| CSELB 2035-200   |                       | 20                     |                   |                          |                       | 65               | 6                       | 6,840                    | 20.96                               | 21.91           | 22.96           | 24.13           | No Interference |                 |                 |                 |
| CSELB 2035-250   |                       | 25                     |                   |                          |                       | 70               | 6                       | 6,840                    | 26.19                               | 27.40           | 28.74           | 30.23           | No Interference |                 |                 |                 |
| CSELB 2035-300   |                       | 30                     |                   |                          |                       | 70               | 6                       | 7,300                    | 31.43                               | 32.90           | 34.52           | 36.32           | No Interference |                 |                 |                 |
| CSELB 2035-400   |                       | 40                     |                   |                          |                       | 90               | 6                       | 9,690                    | 41.90                               | 43.88           | 46.08           | No Interference | No Interference |                 |                 |                 |
| CSELB 2035-450   |                       | 45                     |                   |                          |                       | 90               | 6                       | 10,600                   | 47.13                               | 49.38           | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2040-080   |                       | R2                     |                   |                          |                       | 8                | 3.2                     | 3.95                     | 11°                                 | 70              | 6               | 4,450           | 8.38            | 8.70            | 9.06            | 9.45            |
| CSELB 2040-080-4 | —                     |                        | 70                | 4                        | 4,180                 | No Interference  |                         |                          | No Interference                     | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| CSELB 2040-100   | 10                    |                        | 70                | 6                        | 4,450                 | 10.48            |                         |                          | 10.90                               | 11.37           | 11.89           | 13.12           |                 |                 |                 |                 |
| CSELB 2040-120   | 12                    |                        | 70                | 6                        | 5,810                 | 12.57            |                         |                          | 13.10                               | 13.68           | 14.33           | 15.86           |                 |                 |                 |                 |
| CSELB 2040-140   | 14                    |                        | 70                | 6                        | 5,810                 | 14.67            |                         |                          | 15.30                               | 15.99           | 16.76           | 18.60           |                 |                 |                 |                 |
| CSELB 2040-150   | 15                    |                        | 70                | 6                        | 5,810                 | 15.71            |                         |                          | 16.39                               | 17.15           | 17.98           | 19.97           |                 |                 |                 |                 |
| CSELB 2040-160   | 16                    |                        | 70                | 6                        | 5,810                 | 16.76            |                         |                          | 17.49                               | 18.30           | 19.20           | No Interference |                 |                 |                 |                 |
| CSELB 2040-180   | 18                    |                        | 70                | 6                        | 5,810                 | 18.85            |                         |                          | 19.69                               | 20.61           | 21.64           | No Interference |                 |                 |                 |                 |
| CSELB 2040-200   | 20                    |                        | 70                | 6                        | 5,810                 | 20.95            |                         |                          | 21.89                               | 22.93           | 24.08           | No Interference |                 |                 |                 |                 |
| CSELB 2040-220   | 22                    |                        | 70                | 6                        | 5,810                 | 23.04            |                         |                          | 24.08                               | 25.24           | 26.52           | No Interference |                 |                 |                 |                 |
| CSELB 2040-250   | 25                    |                        | 70                | 6                        | 5,810                 | 26.18            |                         |                          | 27.38                               | 28.70           | 30.17           | No Interference |                 |                 |                 |                 |
| CSELB 2040-270   | 27                    |                        | 70                | 6                        | 5,810                 | 28.28            |                         |                          | 29.58                               | 31.01           | No Interference | No Interference |                 |                 |                 |                 |
| CSELB 2040-300   | 30                    |                        | 70                | 6                        | 5,810                 | 31.42            |                         |                          | 32.87                               | 34.48           | No Interference | No Interference |                 |                 |                 |                 |
| CSELB 2040-320   | 32                    |                        | 80                | 6                        | 6,730                 | 33.51            |                         |                          | 35.07                               | 36.79           | No Interference | No Interference |                 |                 |                 |                 |
| CSELB 2040-350   | 35                    |                        | 80                | 6                        | 6,730                 | 36.65            |                         |                          | 38.37                               | 40.26           | No Interference | No Interference |                 |                 |                 |                 |
| CSELB 2040-400   | 40                    |                        | 90                | 6                        | 7,520                 | 41.89            |                         |                          | 43.86                               | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| CSELB 2040-450   | 45                    |                        | 90                | 6                        | 9,690                 | 47.12            |                         |                          | 49.35                               | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| CSELB 2040-500   | 50                    |                        | 100               | 6                        | 10,370                | 52.36            |                         |                          | 54.85                               | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| CSELB 2040-600   | 60                    |                        | 120               | 6                        | 10,580                | 62.83            |                         |                          | No Interference                     | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| CSELB 2050-100   | R2.5                  |                        | 10                | 4                        | 4.95                  | 11°              |                         |                          | 70                                  | 6               | 6,840           | 10.45           | 10.85           | 11.29           | 11.78           | No Interference |
| CSELB 2050-150   |                       |                        | 15                |                          |                       |                  |                         |                          | 70                                  | 6               | 9,690           | 15.69           | 16.35           | 17.07           | No Interference | No Interference |
| CSELB 2050-200   |                       |                        | 20                |                          |                       |                  |                         |                          | 70                                  | 6               | 9,690           | 20.92           | 21.84           | No Interference | No Interference | No Interference |
| CSELB 2050-250   |                       |                        | 25                |                          |                       |                  |                         |                          | 70                                  | 6               | 9,690           | 26.16           | 27.33           | No Interference | No Interference | No Interference |
| CSELB 2050-300   |                       |                        | 30                |                          |                       |                  |                         |                          | 80                                  | 6               | 10,370          | 31.39           | No Interference | No Interference | No Interference | No Interference |
| CSELB 2050-350   |                       | 35                     | 80                |                          |                       |                  | 6                       | 10,370                   | 36.63                               | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2050-400   |                       | 40                     | 90                |                          |                       |                  | 6                       | 13,110                   | 41.86                               | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2050-450   |                       | 45                     | 100               |                          |                       |                  | 6                       | 13,680                   | 47.10                               | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2050-500   |                       | 50                     | 100               |                          |                       |                  | 6                       | 14,820                   | 52.33                               | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-100   |                       | R3                     | 10                |                          |                       |                  | 4.8                     | 5.95                     | —                                   | 80              | 6               | 7,300           | No Interference | No Interference | No Interference | No Interference |
| CSELB 2060-150   | 15                    |                        | 80                | 6                        | 7,300                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-180   | 18                    |                        | 80                | 6                        | 7,300                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-200   | 20                    |                        | 80                | 6                        | 7,300                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-220   | 22                    |                        | 80                | 6                        | 7,300                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-250   | 25                    |                        | 80                | 6                        | 7,300                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-270   | 27                    |                        | 80                | 6                        | 7,300                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-300   | 30                    |                        | 80                | 6                        | 7,520                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-320   | 32                    |                        | 80                | 6                        | 7,520                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-350   | 35                    |                        | 80                | 6                        | 7,750                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-400   | 40                    |                        | 90                | 6                        | 8,210                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-450   | 45                    |                        | 100               | 6                        | 8,780                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-500   | 50                    |                        | 120               | 6                        | 8,890                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| CSELB 2060-600   | 60                    |                        | 120               | 6                        | 9,420                 | No Interference  |                         |                          |                                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

## Milling Conditions for CSELB

| WORK MATERIAL |                          | COPPER / ALUMINUM ALLOYS |                                    |                    |                                 |                                  | CARBON STEELS / ALLOY STEELS<br>S45C / S50C / SK / SCM<br>(~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>NAK80 / STAVAX / HPM38<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>STAVAX / HPM38 / SKD61<br>(45~55HRC) |                    |                                 |                                  |       |
|---------------|--------------------------|--------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|-------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm)    | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                                 | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |       |
| 2001-002      | R0.05                    | 0.2                      | 54,000                             | 85                 | 0.004                           | 0.004                            | 54,000   | 85                 | 0.004                           | 0.004                            | 48,000   | 55                 | 0.002                           | 0.002                            | 48,000  | 55                 | 0.002                           | 0.002                            |       |
| 2001-003      |                          | 0.3                      | 54,000                             | 85                 | 0.004                           | 0.004                            | 54,000   | 85                 | 0.004                           | 0.004                            | 48,000   | 55                 | 0.002                           | 0.002                            | 48,000  | 55                 | 0.002                           | 0.002                            |       |
| 2001-005      |                          | 0.5                      | 54,000                             | 75                 | 0.004                           | 0.004                            | 54,000   | 75                 | 0.004                           | 0.004                            | 48,000   | 35                 | 0.002                           | 0.002                            | 48,000  | 35                 | 0.002                           | 0.002                            |       |
| 20015-003     | R0.075                   | 0.3                      | 54,000                             | 160                | 0.007                           | 0.009                            | 54,000   | 160                | 0.007                           | 0.009                            | 48,000   | 90                 | 0.004                           | 0.004                            | 48,000  | 90                 | 0.004                           | 0.004                            |       |
| 20015-005     |                          | 0.5                      | 54,000                             | 140                | 0.007                           | 0.009                            | 54,000   | 140                | 0.007                           | 0.009                            | 48,000   | 60                 | 0.004                           | 0.004                            | 48,000  | 60                 | 0.004                           | 0.004                            |       |
| 20015-010     |                          | 1                        | 54,000                             | 100                | 0.003                           | 0.005                            | 54,000   | 100                | 0.003                           | 0.005                            | 48,000   | 60                 | 0.001                           | 0.002                            | 48,000  | 60                 | 0.001                           | 0.002                            |       |
| 2002-003      | R0.1                     | 0.3                      | 60,000                             | 350                | 0.008                           | 0.024                            | 60,000   | 350                | 0.008                           | 0.016                            | 60,000   | 300                | 0.008                           | 0.024                            | 60,000  | 300                | 0.006                           | 0.018                            |       |
| 2002-005      |                          | 0.5                      | 60,000                             | 350                | 0.008                           | 0.024                            | 60,000   | 350                | 0.008                           | 0.016                            | 60,000   | 300                | 0.008                           | 0.024                            | 60,000  | 300                | 0.006                           | 0.018                            |       |
| 2002-0075     |                          | 0.75                     | 60,000                             | 300                | 0.007                           | 0.021                            | 60,000   | 320                | 0.007                           | 0.015                            | 60,000   | 300                | 0.007                           | 0.021                            | 60,000  | 270                | 0.005                           | 0.015                            |       |
| 2002-010      |                          | 1                        | 60,000                             | 250                | 0.006                           | 0.018                            | 60,000   | 250                | 0.005                           | 0.015                            | 60,000   | 250                | 0.006                           | 0.018                            | 60,000  | 220                | 0.005                           | 0.015                            |       |
| 2002-0125     |                          | 1.25                     | 54,000                             | 225                | 0.005                           | 0.016                            | 54,000   | 215                | 0.004                           | 0.013                            | 60,000   | 225                | 0.005                           | 0.016                            | 54,000  | 195                | 0.004                           | 0.013                            |       |
| 2002-015      |                          | 1.5                      | 48,000                             | 200                | 0.005                           | 0.015                            | 48,000   | 180                | 0.004                           | 0.012                            | 60,000   | 200                | 0.005                           | 0.015                            | 48,000  | 170                | 0.004                           | 0.012                            |       |
| 2002-0175     |                          | 1.75                     | 48,000                             | 175                | 0.004                           | 0.012                            | 48,000   | 165                | 0.003                           | 0.01                             | 60,000   | 175                | 0.004                           | 0.012                            | 48,000  | 145                | 0.003                           | 0.009                            |       |
| 2002-020      |                          | 2                        | 48,000                             | 150                | 0.003                           | 0.009                            | 48,000   | 150                | 0.003                           | 0.009                            | 60,000   | 150                | 0.003                           | 0.009                            | 48,000  | 120                | 0.003                           | 0.007                            |       |
| 2002-0225     |                          | 2.25                     | 44,000                             | 125                | 0.003                           | 0.007                            | 44,000   | 125                | 0.003                           | 0.007                            | 53,000   | 125                | 0.002                           | 0.007                            | 44,000  | 110                | 0.002                           | 0.005                            |       |
| 2002-025      |                          | 2.5                      | 40,000                             | 100                | 0.003                           | 0.006                            | 40,000   | 100                | 0.003                           | 0.006                            | 46,000   | 100                | 0.002                           | 0.006                            | 40,000  | 100                | 0.002                           | 0.004                            |       |
| 2002-030      |                          | 3                        | 33,000                             | 50                 | 0.002                           | 0.003                            | 33,000   | 50                 | 0.002                           | 0.003                            | 33,000   | 50                 | 0.002                           | 0.003                            | 33,000  | 50                 | 0.002                           | 0.002                            |       |
| 2003-005      |                          | R0.15                    | 0.5                                | 43,000             | 500                             | 0.012                            | 0.036  | 43,000             | 500                             | 0.012                            | 0.024  | 54,000             | 450                             | 0.012                            | 0.036   | 43,000             | 450                             | 0.008                            | 0.024 |
| 2003-006      |                          |                          | 0.6                                | 43,000             | 500                             | 0.012                            | 0.036  | 43,000             | 500                             | 0.012                            | 0.024  | 54,000             | 450                             | 0.012                            | 0.036   | 43,000             | 450                             | 0.008                            | 0.024 |
| 2003-0075     |                          |                          | 0.75                               | 43,000             | 500                             | 0.012                            | 0.036  | 43,000             | 500                             | 0.012                            | 0.024  | 54,000             | 450                             | 0.012                            | 0.036   | 43,000             | 450                             | 0.008                            | 0.024 |
| 2003-010      |                          |                          | 1                                  | 43,000             | 450                             | 0.01                             | 0.03   | 43,000             | 450                             | 0.008                            | 0.024  | 54,000             | 400                             | 0.01                             | 0.03  | 43,000             | 400                             | 0.007                            | 0.021 |
| 2003-0125     | 1.25                     |                          | 43,000                             | 425                | 0.009                           | 0.027                            | 43,000   | 425                | 0.007                           | 0.022                            | 54,000   | 400                | 0.009                           | 0.027                            | 43,000  | 400                | 0.006                           | 0.019                            |       |
| 2003-015      | 1.5                      |                          | 43,000                             | 400                | 0.008                           | 0.024                            | 43,000   | 400                | 0.007                           | 0.021                            | 54,000   | 400                | 0.008                           | 0.024                            | 43,000  | 400                | 0.006                           | 0.018                            |       |
| 2003-0175     | 1.75                     |                          | 41,500                             | 350                | 0.007                           | 0.021                            | 41,500   | 350                | 0.006                           | 0.019                            | 52,000   | 350                | 0.007                           | 0.022                            | 41,500  | 350                | 0.005                           | 0.016                            |       |
| 2003-020      | 2                        |                          | 40,000                             | 300                | 0.006                           | 0.018                            | 40,000   | 300                | 0.006                           | 0.018                            | 50,000   | 300                | 0.007                           | 0.021                            | 40,000  | 300                | 0.005                           | 0.015                            |       |
| 2003-0225     | 2.25                     |                          | 40,000                             | 275                | 0.005                           | 0.016                            | 40,000   | 275                | 0.005                           | 0.016                            | 48,000   | 275                | 0.006                           | 0.018                            | 40,000  | 275                | 0.004                           | 0.013                            |       |
| 2003-025      | 2.5                      |                          | 40,000                             | 250                | 0.005                           | 0.015                            | 40,000   | 250                | 0.005                           | 0.015                            | 46,000   | 250                | 0.005                           | 0.015                            | 40,000  | 250                | 0.004                           | 0.012                            |       |
| 2003-030      | 3                        |                          | 38,000                             | 200                | 0.004                           | 0.012                            | 38,000   | 200                | 0.004                           | 0.012                            | 42,000   | 200                | 0.004                           | 0.012                            | 38,000  | 200                | 0.004                           | 0.008                            |       |
| 2003-040      | 4                        |                          | 35,000                             | 100                | 0.003                           | 0.009                            | 35,000   | 100                | 0.003                           | 0.009                            | 35,000   | 100                | 0.003                           | 0.009                            | 32,000  | 100                | 0.003                           | 0.005                            |       |
| 2003-050      | 5                        |                          | 26,000                             | 60                 | 0.003                           | 0.004                            | 26,000   | 60                 | 0.003                           | 0.004                            | 26,000   | 60                 | 0.003                           | 0.004                            | 26,000  | 60                 | 0.003                           | 0.003                            |       |
| 2004-005      | R0.2                     |                          | 0.5                                | 35,000             | 1,200                           | 0.03                             | 0.09   | 35,000             | 1,200                           | 0.02                             | 0.04   | 50,000             | 650                             | 0.025                            | 0.075   | 35,000             | 650                             | 0.015                            | 0.045 |
| 2004-0075     |                          |                          | 0.75                               | 35,000             | 1,200                           | 0.03                             | 0.09   | 35,000             | 1,200                           | 0.02                             | 0.04   | 50,000             | 650                             | 0.025                            | 0.075   | 35,000             | 650                             | 0.015                            | 0.045 |
| 2004-010      |                          | 1                        | 35,000                             | 1,200              | 0.03                            | 0.09                             | 35,000   | 1,200              | 0.02                            | 0.04                             | 50,000   | 650                | 0.025                           | 0.075                            | 35,000  | 650                | 0.015                           | 0.045                            |       |
| 2004-0125     |                          | 1.25                     | 35,000                             | 1,050              | 0.025                           | 0.075                            | 35,000   | 1,050              | 0.018                           | 0.036                            | 50,000   | 600                | 0.022                           | 0.067                            | 35,000  | 575                | 0.013                           | 0.04                             |       |
| 2004-015      |                          | 1.5                      | 35,000                             | 900                | 0.02                            | 0.06                             | 35,000   | 900                | 0.016                           | 0.033                            | 50,000   | 550                | 0.02                            | 0.06                             | 35,000  | 500                | 0.012                           | 0.036                            |       |
| 2004-0175     |                          | 1.75                     | 35,000                             | 750                | 0.017                           | 0.052                            | 35,000   | 750                | 0.013                           | 0.033                            | 50,000   | 525                | 0.017                           | 0.052                            | 35,000  | 450                | 0.011                           | 0.033                            |       |
| 2004-020      |                          | 2                        | 35,000                             | 600                | 0.015                           | 0.045                            | 35,000   | 600                | 0.011                           | 0.033                            | 50,000   | 500                | 0.015                           | 0.045                            | 35,000  | 400                | 0.01                            | 0.03                             |       |
| 2004-0225     |                          | 2.25                     | 35,000                             | 525                | 0.013                           | 0.04                             | 35,000   | 525                | 0.01                            | 0.031                            | 48,000   | 475                | 0.013                           | 0.04                             | 35,000  | 380                | 0.01                            | 0.027                            |       |
| 2004-025      |                          | 2.5                      | 35,000                             | 450                | 0.012                           | 0.036                            | 35,000   | 450                | 0.01                            | 0.03                             | 46,000   | 450                | 0.012                           | 0.036                            | 35,000  | 360                | 0.01                            | 0.025                            |       |
| 2004-030      |                          | 3                        | 35,000                             | 400                | 0.01                            | 0.03                             | 35,000   | 400                | 0.008                           | 0.024                            | 42,000   | 400                | 0.01                            | 0.03                             | 35,000  | 330                | 0.007                           | 0.021                            |       |
| 2004-035      |                          | 3.5                      | 35,000                             | 350                | 0.007                           | 0.02                             | 35,000   | 350                | 0.006                           | 0.018                            | 38,000   | 350                | 0.007                           | 0.021                            | 35,000  | 300                | 0.007                           | 0.018                            |       |
| 2004-040      |                          | 4                        | 35,000                             | 300                | 0.005                           | 0.015                            | 35,000   | 300                | 0.005                           | 0.015                            | 35,000   | 300                | 0.005                           | 0.015                            | 35,000  | 250                | 0.005                           | 0.015                            |       |
| 2004-045      |                          | 4.5                      | 32,000                             | 230                | 0.004                           | 0.012                            | 32,000   | 230                | 0.004                           | 0.012                            | 32,000   | 230                | 0.004                           | 0.012                            | 32,000  | 200                | 0.004                           | 0.01                             |       |
| 2004-050      |                          | 5                        | 30,000                             | 160                | 0.003                           | 0.01                             | 30,000   | 160                | 0.003                           | 0.01                             | 30,000   | 160                | 0.003                           | 0.01                             | 30,000  | 150                | 0.003                           | 0.008                            |       |
| 2004-060      |                          | 6                        | 23,000                             | 90                 | 0.003                           | 0.005                            | 23,000   | 90                 | 0.003                           | 0.005                            | 23,000   | 90                 | 0.003                           | 0.005                            | 23,000  | 80                 | 0.003                           | 0.004                            |       |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for CSELB

| WORK MATERIAL |                          |                       | COPPER / ALUMINUM ALLOYS           |                    |                                 |                                  | CARBON STEELS / ALLOY STEELS<br>S45C / S50C / SK / SCM<br>(~32SHB) |                    |                                 |                                  | PREHARDENED STEELS<br>NAK80 / STAVAX / HPM38<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>STAVAX / HPM38 / SKD61<br>(45~55HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                                 | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2005-010      | R0.25                    | 1                     | 34,000                             | 1,300              | 0.035                           | 0.105                            | 34,000   | 1,300              | 0.03                            | 0.06                             | 45,000   | 900                | 0.03                            | 0.09                             | 32,000  | 900                | 0.02                            | 0.06                             |
| 2005-0125     |                          | 1.25                  | 34,000                             | 1,150              | 0.032                           | 0.097                            | 34,000   | 1,150              | 0.027                           | 0.055                            | 45,000   | 850                | 0.027                           | 0.082                            | 32,000  | 850                | 0.019                           | 0.057                            |
| 2005-015      |                          | 1.5                   | 34,000                             | 1,000              | 0.03                            | 0.09                             | 34,000   | 1,000              | 0.025                           | 0.05                             | 45,000   | 800                | 0.025                           | 0.075                            | 32,000  | 800                | 0.018                           | 0.054                            |
| 2005-0175     |                          | 1.75                  | 34,000                             | 900                | 0.027                           | 0.082                            | 34,000   | 900                | 0.024                           | 0.048                            | 45,000   | 750                | 0.023                           | 0.07                             | 32,000  | 750                | 0.017                           | 0.051                            |
| 2005-020      |                          | 2                     | 34,000                             | 800                | 0.025                           | 0.075                            | 34,000   | 800                | 0.023                           | 0.046                            | 45,000   | 700                | 0.022                           | 0.066                            | 32,000  | 700                | 0.016                           | 0.048                            |
| 2005-0225     |                          | 2.25                  | 34,000                             | 750                | 0.022                           | 0.067                            | 34,000   | 750                | 0.019                           | 0.045                            | 45,000   | 650                | 0.02                            | 0.06                             | 32,000  | 650                | 0.015                           | 0.046                            |
| 2005-025      |                          | 2.5                   | 34,000                             | 700                | 0.02                            | 0.06                             | 34,000   | 700                | 0.015                           | 0.045                            | 45,000   | 600                | 0.018                           | 0.054                            | 32,000  | 600                | 0.015                           | 0.045                            |
| 2005-030      |                          | 3                     | 32,000                             | 550                | 0.016                           | 0.048                            | 32,000   | 550                | 0.012                           | 0.036                            | 41,000   | 550                | 0.014                           | 0.042                            | 31,000  | 500                | 0.012                           | 0.036                            |
| 2005-035      |                          | 3.5                   | 32,000                             | 500                | 0.014                           | 0.042                            | 32,000   | 500                | 0.011                           | 0.033                            | 38,000   | 500                | 0.012                           | 0.036                            | 30,500  | 450                | 0.01                            | 0.03                             |
| 2005-040      |                          | 4                     | 31,000                             | 450                | 0.012                           | 0.036                            | 31,000   | 450                | 0.01                            | 0.03                             | 35,000   | 450                | 0.01                            | 0.03                             | 30,000  | 390                | 0.01                            | 0.03                             |
| 2005-045      |                          | 4.5                   | 30,000                             | 390                | 0.01                            | 0.03                             | 30,000   | 390                | 0.008                           | 0.024                            | 32,000   | 390                | 0.008                           | 0.024                            | 29,500  | 350                | 0.008                           | 0.024                            |
| 2005-050      |                          | 5                     | 29,000                             | 340                | 0.007                           | 0.021                            | 29,000   | 340                | 0.007                           | 0.021                            | 29,000   | 340                | 0.006                           | 0.018                            | 29,000  | 300                | 0.006                           | 0.018                            |
| 2005-055      | 5.5                      | 26,000                | 280                                | 0.007              | 0.021                           | 26,000                           | 280  | 0.007              | 0.021                           | 26,000                           | 280  | 0.006              | 0.018                           | 26,000                           | 250   | 0.006              | 0.018                           |                                  |
| 2005-060      | 6                        | 24,000                | 220                                | 0.006              | 0.018                           | 24,000                           | 220  | 0.006              | 0.018                           | 24,000                           | 220  | 0.005              | 0.015                           | 24,000                           | 200   | 0.005              | 0.015                           |                                  |
| 2005-070      | 7                        | 21,000                | 180                                | 0.005              | 0.015                           | 21,000                           | 180  | 0.005              | 0.015                           | 21,000                           | 180  | 0.004              | 0.012                           | 21,000                           | 160   | 0.004              | 0.012                           |                                  |
| 2005-080      | 8                        | 19,000                | 130                                | 0.004              | 0.012                           | 19,000                           | 130  | 0.004              | 0.012                           | 19,000                           | 130  | 0.003              | 0.009                           | 19,000                           | 110   | 0.003              | 0.009                           |                                  |
| 2005-090      | 9                        | 18,000                | 120                                | 0.003              | 0.009                           | 18,000                           | 120  | 0.003              | 0.009                           | 18,000                           | 120  | 0.002              | 0.008                           | 18,000                           | 100   | 0.002              | 0.008                           |                                  |
| 2005-100      | 10                       | 17,000                | 100                                | 0.003              | 0.009                           | 17,000                           | 100  | 0.003              | 0.009                           | 17,000                           | 100  | 0.002              | 0.006                           | 17,000                           | 80  | 0.002              | 0.006                           |                                  |
| 2006-010      | R0.3                     | 1                     | 33,000                             | 1,500              | 0.05                            | 0.15                             | 33,000   | 1,500              | 0.04                            | 0.08                             | 40,000   | 1,300              | 0.045                           | 0.09                             | 30,000  | 1,300              | 0.04                            | 0.06                             |
| 2006-0125     |                          | 1.25                  | 33,000                             | 1,500              | 0.05                            | 0.15                             | 33,000   | 1,500              | 0.04                            | 0.08                             | 40,000   | 1,300              | 0.045                           | 0.09                             | 30,000  | 1,300              | 0.04                            | 0.06                             |
| 2006-015      |                          | 1.5                   | 33,000                             | 1,500              | 0.05                            | 0.15                             | 33,000   | 1,500              | 0.04                            | 0.08                             | 40,000   | 1,300              | 0.045                           | 0.09                             | 30,000  | 1,300              | 0.04                            | 0.06                             |
| 2006-0175     |                          | 1.75                  | 33,000                             | 1,450              | 0.047                           | 0.142                            | 33,000   | 1,450              | 0.038                           | 0.076                            | 40,000   | 1,250              | 0.045                           | 0.09                             | 30,000  | 1,250              | 0.038                           | 0.057                            |
| 2006-020      |                          | 2                     | 33,000                             | 1,400              | 0.045                           | 0.135                            | 33,000   | 1,400              | 0.036                           | 0.072                            | 40,000   | 1,200              | 0.045                           | 0.09                             | 30,000  | 1,200              | 0.036                           | 0.054                            |
| 2006-0225     |                          | 2.25                  | 33,000                             | 1,250              | 0.042                           | 0.127                            | 33,000   | 1,300              | 0.034                           | 0.069                            | 40,000   | 1,100              | 0.042                           | 0.085                            | 30,000  | 1,150              | 0.034                           | 0.053                            |
| 2006-025      |                          | 2.5                   | 33,000                             | 1,100              | 0.04                            | 0.12                             | 33,000   | 1,200              | 0.033                           | 0.066                            | 40,000   | 1,000              | 0.04                            | 0.08                             | 30,000  | 1,100              | 0.033                           | 0.053                            |
| 2006-030      |                          | 3                     | 33,000                             | 900                | 0.035                           | 0.105                            | 33,000   | 900                | 0.025                           | 0.066                            | 40,000   | 800                | 0.03                            | 0.075                            | 30,000  | 900                | 0.026                           | 0.052                            |
| 2006-035      |                          | 3.5                   | 32,000                             | 900                | 0.03                            | 0.09                             | 32,000   | 800                | 0.022                           | 0.066                            | 38,000   | 650                | 0.025                           | 0.075                            | 28,000  | 720                | 0.02                            | 0.06                             |
| 2006-040      |                          | 4                     | 31,000                             | 700                | 0.027                           | 0.081                            | 31,000   | 700                | 0.02                            | 0.06                             | 35,000   | 560                | 0.022                           | 0.066                            | 28,000  | 600                | 0.018                           | 0.054                            |
| 2006-045      |                          | 4.5                   | 29,000                             | 500                | 0.024                           | 0.072                            | 29,000   | 550                | 0.017                           | 0.051                            | 32,000   | 500                | 0.018                           | 0.054                            | 26,000  | 500                | 0.015                           | 0.045                            |
| 2006-050      |                          | 5                     | 29,000                             | 440                | 0.018                           | 0.054                            | 29,000   | 440                | 0.015                           | 0.045                            | 29,000   | 440                | 0.015                           | 0.045                            | 26,000  | 440                | 0.012                           | 0.036                            |
| 2006-055      | 5.5                      | 26,000                | 410                                | 0.016              | 0.048                           | 26,000                           | 410  | 0.014              | 0.042                           | 26,000                           | 410  | 0.014              | 0.042                           | 25,000                           | 410   | 0.01               | 0.03                            |                                  |
| 2006-060      | 6                        | 24,000                | 380                                | 0.012              | 0.036                           | 24,000                           | 380  | 0.012              | 0.036                           | 24,000                           | 380  | 0.01               | 0.03                            | 24,000                           | 380   | 0.008              | 0.024                           |                                  |
| 2006-065      | 6.5                      | 22,000                | 340                                | 0.011              | 0.033                           | 22,000                           | 340  | 0.011              | 0.033                           | 22,000                           | 340  | 0.009              | 0.027                           | 22,000                           | 340   | 0.007              | 0.021                           |                                  |
| 2006-070      | 7                        | 21,000                | 310                                | 0.01               | 0.03                            | 21,000                           | 310  | 0.01               | 0.03                            | 21,000                           | 310  | 0.008              | 0.024                           | 21,000                           | 310   | 0.006              | 0.018                           |                                  |
| 2006-080      | 8                        | 18,000                | 240                                | 0.008              | 0.024                           | 18,000                           | 240  | 0.008              | 0.024                           | 18,000                           | 240  | 0.006              | 0.018                           | 18,000                           | 240   | 0.005              | 0.015                           |                                  |
| 2006-090      | 9                        | 16,000                | 180                                | 0.007              | 0.021                           | 16,000                           | 180  | 0.007              | 0.021                           | 16,000                           | 180  | 0.005              | 0.015                           | 16,000                           | 180   | 0.004              | 0.012                           |                                  |
| 2006-100      | 10                       | 15,000                | 160                                | 0.006              | 0.018                           | 15,000                           | 160  | 0.006              | 0.018                           | 15,000                           | 160  | 0.004              | 0.012                           | 15,000                           | 160   | 0.003              | 0.01                            |                                  |
| 2006-120      | 12                       | 14,000                | 150                                | 0.005              | 0.015                           | 14,000                           | 150  | 0.005              | 0.015                           | 14,000                           | 150  | 0.003              | 0.009                           | 14,000                           | 150   | 0.002              | 0.008                           |                                  |
| 2007-020      | R0.35                    | 2                     | 32,000                             | 1,800              | 0.07                            | 0.21                             | 32,000   | 1,600              | 0.05                            | 0.1                              | 38,000   | 1,600              | 0.06                            | 0.12                             | 28,000  | 1,600              | 0.05                            | 0.075                            |
| 2007-040      |                          | 4                     | 32,000                             | 1,000              | 0.05                            | 0.15                             | 32,000   | 900                | 0.03                            | 0.09                             | 34,000   | 800                | 0.04                            | 0.12                             | 28,000  | 800                | 0.03                            | 0.06                             |
| 2007-060      |                          | 6                     | 26,000                             | 550                | 0.022                           | 0.066                            | 26,000   | 550                | 0.018                           | 0.054                            | 26,000   | 500                | 0.018                           | 0.054                            | 23,000  | 500                | 0.014                           | 0.042                            |
| 2007-080      |                          | 8                     | 19,000                             | 340                | 0.012                           | 0.036                            | 19,000   | 340                | 0.012                           | 0.036                            | 19,000   | 320                | 0.01                            | 0.03                             | 19,000  | 320                | 0.008                           | 0.024                            |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



## Milling Conditions for CSELB

| WORK MATERIAL |                          |                       | COPPER / ALUMINUM ALLOYS           |                    |                                 |                                  | CARBON STEELS / ALLOY STEELS<br>S45C / S50C / SK / SCM<br>(~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>NAK80 / STAVAX / HPM38<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>STAVAX / HPM38 / SKD61<br>(45~55HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                                 | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2008-020      | R0.4                     | 2                     | 30,000                             | 2,200              | 0.1                             | 0.3                              | 30,000   | 1,800              | 0.06                            | 0.12                             | 35,000   | 1,800              | 0.07                            | 0.14                             | 25,000  | 1,700              | 0.07                            | 0.1                              |
| 2008-030      |                          | 3                     | 30,000                             | 1,700              | 0.08                            | 0.24                             | 30,000   | 1,600              | 0.05                            | 0.1                              | 35,000   | 1,600              | 0.06                            | 0.12                             | 25,000  | 1,500              | 0.06                            | 0.09                             |
| 2008-040      |                          | 4                     | 30,000                             | 1,400              | 0.07                            | 0.21                             | 30,000   | 1,300              | 0.04                            | 0.1                              | 35,000   | 1,300              | 0.05                            | 0.12                             | 25,000  | 1,200              | 0.045                           | 0.09                             |
| 2008-050      |                          | 5                     | 30,000                             | 1,100              | 0.06                            | 0.18                             | 30,000   | 1,100              | 0.035                           | 0.1                              | 30,000   | 1,100              | 0.04                            | 0.12                             | 25,000  | 1,000              | 0.04                            | 0.08                             |
| 2008-060      |                          | 6                     | 27,000                             | 900                | 0.04                            | 0.12                             | 27,000   | 900                | 0.025                           | 0.075                            | 27,000   | 800                | 0.03                            | 0.09                             | 23,000  | 800                | 0.023                           | 0.069                            |
| 2008-070      |                          | 7                     | 24,000                             | 700                | 0.025                           | 0.075                            | 24,000   | 700                | 0.022                           | 0.066                            | 24,000   | 600                | 0.02                            | 0.06                             | 21,000  | 600                | 0.015                           | 0.045                            |
| 2008-080      |                          | 8                     | 19,000                             | 450                | 0.02                            | 0.06                             | 19,000   | 450                | 0.02                            | 0.06                             | 19,000   | 450                | 0.015                           | 0.045                            | 19,000  | 450                | 0.01                            | 0.03                             |
| 2008-090      |                          | 9                     | 18,000                             | 400                | 0.016                           | 0.048                            | 18,000   | 400                | 0.016                           | 0.048                            | 18,000   | 360                | 0.013                           | 0.039                            | 18,000  | 360                | 0.009                           | 0.027                            |
| 2008-100      |                          | 10                    | 15,000                             | 350                | 0.012                           | 0.036                            | 15,000   | 350                | 0.012                           | 0.036                            | 15,000   | 300                | 0.01                            | 0.03                             | 15,000  | 300                | 0.007                           | 0.021                            |
| 2008-120      |                          | 12                    | 14,000                             | 300                | 0.01                            | 0.03                             | 14,000   | 300                | 0.01                            | 0.03                             | 14,000   | 240                | 0.006                           | 0.018                            | 14,000  | 240                | 0.006                           | 0.018                            |
| 2008-160      | 16                       | 13,500                | 240                                | 0.006              | 0.018                           | 13,500                           | 240  | 0.006              | 0.018                           | 13,500                           | 190  | 0.003              | 0.01                            | 13,500                           | 190   | 0.003              | 0.01                            |                                  |
| 2009-020      | R0.45                    | 2                     | 30,000                             | 2,100              | 0.11                            | 0.33                             | 30,000   | 1,600              | 0.07                            | 0.14                             | 33,000   | 1,700              | 0.08                            | 0.16                             | 24,000  | 1,600              | 0.08                            | 0.12                             |
| 2009-040      |                          | 4                     | 30,000                             | 1,600              | 0.08                            | 0.24                             | 30,000   | 1,500              | 0.055                           | 0.12                             | 33,000   | 1,400              | 0.06                            | 0.14                             | 24,000  | 1,300              | 0.05                            | 0.1                              |
| 2009-060      |                          | 6                     | 27,000                             | 1,100              | 0.06                            | 0.18                             | 27,000   | 1,100              | 0.035                           | 0.1                              | 27,000   | 850                | 0.04                            | 0.12                             | 22,000  | 800                | 0.034                           | 0.1                              |
| 2009-080      |                          | 8                     | 22,000                             | 710                | 0.03                            | 0.09                             | 22,000   | 700                | 0.023                           | 0.069                            | 22,000   | 560                | 0.021                           | 0.063                            | 18,500  | 550                | 0.017                           | 0.051                            |
| 2009-100      |                          | 10                    | 18,000                             | 500                | 0.02                            | 0.06                             | 18,000   | 500                | 0.018                           | 0.054                            | 18,000   | 430                | 0.015                           | 0.045                            | 18,000  | 430                | 0.01                            | 0.03                             |
| 2009-120      |                          | 12                    | 16,000                             | 420                | 0.015                           | 0.045                            | 16,000   | 420                | 0.015                           | 0.045                            | 16,000   | 350                | 0.009                           | 0.027                            | 16,000  | 350                | 0.007                           | 0.021                            |
| 2009-140      |                          | 14                    | 14,000                             | 380                | 0.012                           | 0.042                            | 14,000   | 380                | 0.012                           | 0.042                            | 14,000   | 280                | 0.006                           | 0.018                            | 14,000  | 280                | 0.006                           | 0.018                            |
| 2009-160      |                          | 16                    | 13,500                             | 360                | 0.01                            | 0.04                             | 13,500   | 360                | 0.01                            | 0.04                             | 13,500   | 200                | 0.004                           | 0.016                            | 13,500  | 200                | 0.004                           | 0.016                            |
| 2009-180      |                          | 18                    | 13,000                             | 340                | 0.006                           | 0.024                            | 13,000   | 340                | 0.006                           | 0.024                            | 13,000   | 120                | 0.003                           | 0.012                            | 13,000  | 120                | 0.003                           | 0.012                            |
| 2010-020      |                          | R0.5                  | 2                                  | 30,000             | 2,000                           | 0.12                             | 0.36   | 30,000             | 1,600                           | 0.08                             | 0.16   | 30,000             | 1,600                           | 0.09                             | 0.18  | 22,000             | 1,600                           | 0.09                             |
| 2010-025      | 2.5                      |                       | 30,000                             | 2,000              | 0.12                            | 0.36                             | 30,000   | 1,600              | 0.08                            | 0.16                             | 30,000   | 1,600              | 0.09                            | 0.18                             | 22,000  | 1,600              | 0.09                            | 0.13                             |
| 2010-030      | 3                        |                       | 30,000                             | 1,800              | 0.11                            | 0.33                             | 24,000   | 1,600              | 0.07                            | 0.14                             | 30,000   | 1,500              | 0.08                            | 0.16                             | 21,500  | 1,400              | 0.08                            | 0.12                             |
| 2010-040      | 4                        |                       | 30,000                             | 1,700              | 0.09                            | 0.27                             | 24,000   | 1,500              | 0.065                           | 0.13                             | 30,000   | 1,300              | 0.075                           | 0.15                             | 21,500  | 1,300              | 0.075                           | 0.1                              |
| 2010-050      | 5                        |                       | 30,000                             | 1,600              | 0.08                            | 0.24                             | 24,000   | 1,400              | 0.06                            | 0.12                             | 30,000   | 1,200              | 0.07                            | 0.14                             | 21,500  | 1,200              | 0.06                            | 0.09                             |
| 2010-060      | 6                        |                       | 30,000                             | 1,400              | 0.06                            | 0.18                             | 18,000   | 1,200              | 0.04                            | 0.12                             | 30,000   | 1,100              | 0.06                            | 0.12                             | 21,500  | 1,100              | 0.05                            | 0.1                              |
| 2010-070      | 7                        |                       | 27,000                             | 1,200              | 0.05                            | 0.15                             | 17,000   | 1,000              | 0.03                            | 0.09                             | 24,000   | 800                | 0.04                            | 0.12                             | 20,000  | 900                | 0.03                            | 0.09                             |
| 2010-080      | 8                        |                       | 24,000                             | 1,000              | 0.04                            | 0.12                             | 16,500   | 900                | 0.027                           | 0.081                            | 18,500   | 620                | 0.035                           | 0.1                              | 18,500  | 580                | 0.025                           | 0.1                              |
| 2010-090      | 9                        |                       | 22,000                             | 720                | 0.035                           | 0.11                             | 15,500   | 700                | 0.02                            | 0.08                             | 16,500   | 550                | 0.025                           | 0.1                              | 16,500  | 500                | 0.02                            | 0.08                             |
| 2010-100      | 10                       |                       | 20,000                             | 650                | 0.03                            | 0.09                             | 15,000   | 500                | 0.018                           | 0.072                            | 14,800   | 490                | 0.02                            | 0.08                             | 14,800  | 430                | 0.015                           | 0.06                             |
| 2010-120      | 12                       |                       | 18,000                             | 600                | 0.02                            | 0.08                             | 15,000   | 500                | 0.016                           | 0.064                            | 13,400   | 380                | 0.01                            | 0.05                             | 13,400  | 380                | 0.008                           | 0.04                             |
| 2010-140      | 14                       |                       | 16,000                             | 530                | 0.015                           | 0.06                             | 14,000   | 460                | 0.015                           | 0.06                             | 12,000   | 350                | 0.008                           | 0.04                             | 12,000  | 350                | 0.006                           | 0.03                             |
| 2010-160      | 16                       |                       | 14,000                             | 460                | 0.014                           | 0.056                            | 14,000   | 460                | 0.014                           | 0.056                            | 10,500   | 250                | 0.005                           | 0.025                            | 10,500  | 250                | 0.005                           | 0.025                            |
| 2010-180      | 18                       |                       | 13,500                             | 440                | 0.012                           | 0.06                             | 13,500   | 440                | 0.012                           | 0.06                             | 9,500  | 200                | 0.004                           | 0.02                             | 9,500   | 200                | 0.004                           | 0.02                             |
| 2010-200      | 20                       | 13,000                | 430                                | 0.008              | 0.04                            | 13,000                           | 430  | 0.008              | 0.04                            | 9,000                            | 150  | 0.003              | 0.015                           | 9,000                            | 150   | 0.003              | 0.015                           |                                  |
| 2010-220      | 22                       | 12,000                | 380                                | 0.007              | 0.035                           | 12,000                           | 380  | 0.007              | 0.035                           | 8,500                            | 120  | 0.002              | 0.01                            | 8,500                            | 120   | 0.002              | 0.01                            |                                  |
| 2012-025      | R0.6                     | 2.5                   | 30,000                             | 2,000              | 0.13                            | 0.39                             | 30,000   | 1,600              | 0.09                            | 0.18                             | 30,000   | 1,600              | 0.1                             | 0.2                              | 18,000  | 1,600              | 0.1                             | 0.15                             |
| 2012-040      |                          | 4                     | 30,000                             | 1,800              | 0.12                            | 0.36                             | 20,000   | 1,500              | 0.08                            | 0.16                             | 30,000   | 1,400              | 0.09                            | 0.18                             | 18,000  | 1,400              | 0.09                            | 0.13                             |
| 2012-060      |                          | 6                     | 30,000                             | 1,600              | 0.09                            | 0.27                             | 20,000   | 1,200              | 0.07                            | 0.14                             | 30,000   | 1,100              | 0.08                            | 0.16                             | 18,000  | 1,100              | 0.08                            | 0.12                             |
| 2012-080      |                          | 8                     | 25,000                             | 1,200              | 0.06                            | 0.18                             | 15,000   | 900                | 0.05                            | 0.12                             | 20,000   | 800                | 0.06                            | 0.15                             | 16,500  | 750                | 0.05                            | 0.11                             |
| 2012-100      |                          | 10                    | 20,000                             | 900                | 0.05                            | 0.15                             | 13,500   | 650                | 0.035                           | 0.11                             | 16,000   | 640                | 0.045                           | 0.12                             | 15,500  | 550                | 0.03                            | 0.09                             |
| 2012-120      |                          | 12                    | 16,500                             | 600                | 0.035                           | 0.12                             | 12,500   | 480                | 0.025                           | 0.1                              | 12,000   | 440                | 0.03                            | 0.12                             | 12,500  | 430                | 0.018                           | 0.072                            |
| 2012-140      |                          | 14                    | 14,500                             | 520                | 0.025                           | 0.1                              | 12,500   | 480                | 0.022                           | 0.088                            | 11,000   | 400                | 0.015                           | 0.06                             | 11,500  | 370                | 0.014                           | 0.056                            |
| 2012-160      |                          | 16                    | 13,000                             | 470                | 0.018                           | 0.072                            | 11,500   | 440                | 0.018                           | 0.072                            | 10,000   | 350                | 0.01                            | 0.05                             | 10,000  | 350                | 0.01                            | 0.05                             |
| 2012-180      |                          | 18                    | 12,000                             | 460                | 0.014                           | 0.07                             | 11,250   | 440                | 0.014                           | 0.07                             | 9,500  | 260                | 0.008                           | 0.04                             | 9,500   | 260                | 0.007                           | 0.035                            |
| 2012-200      |                          | 20                    | 11,000                             | 440                | 0.013                           | 0.065                            | 11,000   | 440                | 0.013                           | 0.065                            | 9,000  | 220                | 0.006                           | 0.03                             | 9,000   | 220                | 0.005                           | 0.025                            |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Milling Conditions for CSELB

| WORK MATERIAL |                          |                       | COPPER / ALUMINUM ALLOYS           |                    |                                 |                                  | CARBON STEELS / ALLOY STEELS<br>S45C / S50C / SK / SCM<br>(~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>NAK80 / STAVAX / HPM38<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>STAVAX / HPM38 / SKD61<br>(45~55HRC) |                    |                                 |                                  |      |
|---------------|--------------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                                 | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |      |
| 2014-060      | R0.7                     | 6                     | 30,000                             | 1,700              | 0.11                            | 0.33                             | 23,000   | 1,500              | 0.08                            | 0.16                             | 30,000   | 1,300              | 0.09                            | 0.18                             | 16,000  | 1,200              | 0.09                            | 0.13                             |      |
| 2014-080      |                          | 8                     | 30,000                             | 1,400              | 0.09                            | 0.27                             | 17,000   | 1,000              | 0.06                            | 0.15                             | 30,000   | 1,000              | 0.07                            | 0.17                             | 15,000  | 900                | 0.06                            | 0.12                             |      |
| 2014-120      |                          | 12                    | 17,000                             | 900                | 0.06                            | 0.18                             | 13,000   | 600                | 0.04                            | 0.12                             | 13,000   | 580                | 0.045                           | 0.14                             | 12,500  | 550                | 0.03                            | 0.1                              |      |
| 2014-160      |                          | 16                    | 12,500                             | 540                | 0.028                           | 0.12                             | 11,000   | 500                | 0.024                           | 0.1                              | 9,500  | 380                | 0.016                           | 0.08                             | 9,500   | 380                | 0.015                           | 0.06                             |      |
| 2015-030      | R0.75                    | 3                     | 30,000                             | 2,000              | 0.15                            | 0.45                             | 30,000   | 1,600              | 0.12                            | 0.24                             | 30,000   | 1,700              | 0.12                            | 0.24                             | 18,000  | 1,500              | 0.12                            | 0.18                             |      |
| 2015-040      |                          | 4                     | 30,000                             | 1,800              | 0.14                            | 0.42                             | 30,000   | 1,500              | 0.11                            | 0.22                             | 30,000   | 1,600              | 0.11                            | 0.22                             | 18,000  | 1,400              | 0.11                            | 0.17                             |      |
| 2015-060      |                          | 6                     | 30,000                             | 1,800              | 0.12                            | 0.36                             | 23,000   | 1,300              | 0.1                             | 0.2                              | 30,000   | 1,400              | 0.1                             | 0.2                              | 15,000  | 1,200              | 0.1                             | 0.16                             |      |
| 2015-080      |                          | 8                     | 30,000                             | 1,600              | 0.11                            | 0.33                             | 18,000   | 1,100              | 0.08                            | 0.16                             | 30,000   | 1,200              | 0.08                            | 0.2                              | 14,000  | 1,000              | 0.08                            | 0.16                             |      |
| 2015-100      |                          | 10                    | 23,000                             | 1,200              | 0.09                            | 0.27                             | 15,000   | 850                | 0.06                            | 0.15                             | 23,500   | 900                | 0.06                            | 0.18                             | 14,000  | 700                | 0.05                            | 0.15                             |      |
| 2015-120      |                          | 12                    | 16,000                             | 900                | 0.07                            | 0.21                             | 13,000   | 600                | 0.05                            | 0.15                             | 13,000   | 650                | 0.05                            | 0.15                             | 13,000  | 550                | 0.03                            | 0.12                             |      |
| 2015-140      |                          | 14                    | 14,500                             | 700                | 0.05                            | 0.19                             | 10,500   | 550                | 0.04                            | 0.12                             | 10,500   | 500                | 0.04                            | 0.12                             | 10,500  | 470                | 0.025                           | 0.1                              |      |
| 2015-160      |                          | 16                    | 13,000                             | 650                | 0.04                            | 0.16                             | 10,000   | 550                | 0.03                            | 0.12                             | 8,850  | 400                | 0.03                            | 0.12                             | 8,850   | 390                | 0.02                            | 0.08                             |      |
| 2015-180      |                          | 18                    | 12,000                             | 580                | 0.03                            | 0.15                             | 10,000   | 510                | 0.025                           | 0.1                              | 8,500  | 350                | 0.018                           | 0.09                             | 8,500   | 360                | 0.014                           | 0.07                             |      |
| 2015-200      |                          | 20                    | 10,500                             | 530                | 0.02                            | 0.1                              | 9,200  | 470                | 0.02                            | 0.1                              | 8,000  | 320                | 0.012                           | 0.06                             | 8,000   | 320                | 0.012                           | 0.06                             |      |
| 2015-220      |                          | 22                    | 10,000                             | 500                | 0.015                           | 0.075                            | 9,000  | 460                | 0.015                           | 0.075                            | 7,500  | 270                | 0.01                            | 0.05                             | 7,500   | 270                | 0.008                           | 0.04                             |      |
| 2015-250      |                          | 25                    | 9,000                              | 440                | 0.014                           | 0.07                             | 8,750  | 440                | 0.014                           | 0.07                             | 7,250  | 250                | 0.008                           | 0.04                             | 7,250   | 250                | 0.006                           | 0.03                             |      |
| 2015-300      |                          | 30                    | 8,500                              | 420                | 0.012                           | 0.06                             | 8,500  | 420                | 0.012                           | 0.06                             | 7,000  | 130                | 0.006                           | 0.03                             | 7,000   | 130                | 0.004                           | 0.02                             |      |
| 2016-040      |                          | R0.8                  | 4                                  | 30,000             | 2,000                           | 0.16                             | 0.48   | 30,000             | 1,600                           | 0.12                             | 0.24   | 30,000             | 1,800                           | 0.12                             | 0.36  | 18,000             | 1,400                           | 0.1                              | 0.2  |
| 2016-080      |                          |                       | 8                                  | 30,000             | 1,700                           | 0.15                             | 0.45   | 15,000             | 1,100                           | 0.1                              | 0.2  | 30,000             | 1,500                           | 0.12                             | 0.24  | 13,500             | 1,000                           | 0.08                             | 0.24 |
| 2016-120      |                          |                       | 12                                 | 23,000             | 1,200                           | 0.1                              | 0.3  | 11,000             | 700                             | 0.06                             | 0.18   | 18,000             | 1,000                           | 0.06                             | 0.18  | 12,500             | 650                             | 0.04                             | 0.16 |
| 2016-160      | 16                       |                       | 15,000                             | 800                | 0.05                            | 0.2                              | 10,000   | 530                | 0.034                           | 0.13                             | 10,000   | 530                | 0.035                           | 0.14                             | 9,000   | 420                | 0.02                            | 0.1                              |      |
| 2016-200      | 20                       |                       | 11,000                             | 580                | 0.034                           | 0.17                             | 9,400  | 490                | 0.025                           | 0.12                             | 8,500  | 400                | 0.018                           | 0.09                             | 7,800   | 380                | 0.014                           | 0.07                             |      |
| 2018-040      | 4                        |                       | 30,000                             | 2,000              | 0.18                            | 0.54                             | 30,000   | 1,800              | 0.16                            | 0.32                             | 30,000   | 1,900              | 0.16                            | 0.48                             | 16,000  | 1,300              | 0.14                            | 0.28                             |      |
| 2018-060      | 6                        |                       | 30,000                             | 1,800              | 0.18                            | 0.52                             | 24,000   | 1,500              | 0.15                            | 0.29                             | 30,000   | 1,700              | 0.16                            | 0.4                              | 14,000  | 1,200              | 0.13                            | 0.27                             |      |
| 2018-080      | 8                        |                       | 30,000                             | 1,800              | 0.17                            | 0.5                              | 18,000   | 1,200              | 0.13                            | 0.26                             | 30,000   | 1,700              | 0.16                            | 0.32                             | 12,000  | 1,000              | 0.11                            | 0.26                             |      |
| 2018-100      | 10                       | 30,000                | 1,800                              | 0.16               | 0.48                            | 15,000                           | 1,100  | 0.11               | 0.23                            | 24,000                           | 1,400  | 0.12               | 0.28                            | 12,000                           | 900   | 0.09               | 0.23                            |                                  |      |
| 2018-120      | 12                       | 24,000                | 1,450                              | 0.12               | 0.36                            | 13,000                           | 1,000  | 0.08               | 0.2                             | 18,000                           | 1,100  | 0.09               | 0.23                            | 12,000                           | 750   | 0.07               | 0.21                            |                                  |      |
| 2018-160      | R0.9                     | 16                    | 15,000                             | 900                | 0.07                            | 0.3                              | 12,000   | 750                | 0.05                            | 0.18                             | 15,000   | 750                | 0.04                            | 0.14                             | 9,500   | 480                | 0.025                           | 0.11                             |      |
| 2018-180      |                          | 18                    | 13,000                             | 800                | 0.06                            | 0.24                             | 11,000   | 650                | 0.04                            | 0.16                             | 11,000   | 600                | 0.035                           | 0.14                             | 8,800   | 440                | 0.02                            | 0.1                              |      |
| 2018-200      |                          | 20                    | 11,500                             | 650                | 0.05                            | 0.2                              | 9,500  | 600                | 0.03                            | 0.15                             | 8,500  | 450                | 0.025                           | 0.11                             | 8,300   | 420                | 0.018                           | 0.08                             |      |
| 2018-220      |                          | 22                    | 10,000                             | 590                | 0.035                           | 0.18                             | 8,500  | 550                | 0.03                            | 0.14                             | 8,000  | 400                | 0.02                            | 0.1                              | 7,800   | 400                | 0.015                           | 0.075                            |      |
| 2018-250      |                          | 25                    | 8,000                              | 500                | 0.035                           | 0.17                             | 8,000  | 480                | 0.025                           | 0.12                             | 7,000  | 350                | 0.018                           | 0.09                             | 7,000   | 350                | 0.012                           | 0.06                             |      |
| 2018-300      |                          | 30                    | 7,500                              | 450                | 0.025                           | 0.13                             | 7,500  | 420                | 0.02                            | 0.08                             | 6,500  | 280                | 0.014                           | 0.07                             | 6,500   | 280                | 0.008                           | 0.04                             |      |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



# Milling Conditions for CSELB

| WORK MATERIAL |                          | COPPER / ALUMINUM ALLOYS |                                    |                    |                                 |                                  | CARBON STEELS / ALLOY STEELS<br>S45C / S50C / SK / SCM<br>(~325HB) |                    |                                 |                                  |                                    | PREHARDENED STEELS<br>NAK80 / STAVAX / HPM38<br>(30~45HRC) |                                 |                                  |                                    | HARDENED STEELS<br>STAVAX / HPM38 / SKD61<br>(45~55HRC) |                                 |                                  |      |
|---------------|--------------------------|--------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|------------------------------------|--|---------------------------------|----------------------------------|------------------------------------|---|---------------------------------|----------------------------------|------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm)    | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                                 | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)   | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)                                      | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |      |
| 2020-030      | R1                       | 3                        | 30,000                             | 2,000              | 0.2                             | 0.6                              | 30,000   | 2,000              | 0.21                            | 0.42                             | 30,000                             | 2,000  | 0.2                             | 0.6                              | 16,000                             | 1,300   | 0.17                            | 0.5                              |      |
| 2020-040      |                          | 4                        | 30,000                             | 2,000              | 0.2                             | 0.6                              | 30,000   | 2,000              | 0.21                            | 0.42                             | 30,000                             | 2,000  | 0.2                             | 0.6                              | 16,000                             | 1,300   | 0.17                            | 0.5                              |      |
| 2020-060      |                          | 6                        | 30,000                             | 2,000              | 0.2                             | 0.6                              | 30,000   | 2,000              | 0.21                            | 0.42                             | 30,000                             | 2,000  | 0.2                             | 0.6                              | 14,000                             | 1,100   | 0.15                            | 0.4                              |      |
| 2020-080      |                          | 8                        | 30,000                             | 2,000              | 0.2                             | 0.6                              | 30,000   | 2,000              | 0.18                            | 0.36                             | 30,000                             | 2,000  | 0.16                            | 0.56                             | 12,000                             | 950   | 0.12                            | 0.4                              |      |
| 2020-100      |                          | 10                       | 30,000                             | 2,000              | 0.2                             | 0.6                              | 30,000   | 2,000              | 0.14                            | 0.42                             | 30,000                             | 2,000  | 0.13                            | 0.45                             | 10,800                             | 850   | 0.1                             | 0.4                              |      |
| 2020-120      |                          | 12                       | 30,000                             | 2,000              | 0.18                            | 0.54                             | 30,000   | 2,000              | 0.12                            | 0.36                             | 30,000                             | 2,000  | 0.1                             | 0.35                             | 10,800                             | 850   | 0.08                            | 0.32                             |      |
| 2020-130      |                          | 13                       | 26,000                             | 1,700              | 0.17                            | 0.52                             | 26,000   | 1,700              | 0.11                            | 0.34                             | 25,000                             | 1,600  | 0.09                            | 0.3                              | 10,800                             | 850   | 0.07                            | 0.28                             |      |
| 2020-140      |                          | 14                       | 22,000                             | 1,450              | 0.15                            | 0.5                              | 22,000   | 1,450              | 0.11                            | 0.33                             | 20,000                             | 1,300  | 0.08                            | 0.24                             | 10,800                             | 850   | 0.06                            | 0.24                             |      |
| 2020-160      |                          | 16                       | 15,000                             | 1,000              | 0.1                             | 0.4                              | 15,000   | 1,000              | 0.07                            | 0.28                             | 10,800                             | 700  | 0.06                            | 0.18                             | 10,800                             | 600   | 0.03                            | 0.15                             |      |
| 2020-180      |                          | 18                       | 13,500                             | 900                | 0.08                            | 0.32                             | 13,500   | 900                | 0.06                            | 0.24                             | 9,700                              | 600  | 0.05                            | 0.15                             | 9,700                              | 520   | 0.025                           | 0.12                             |      |
| 2020-200      |                          | 20                       | 12,000                             | 800                | 0.07                            | 0.28                             | 12,000   | 800                | 0.05                            | 0.2                              | 8,650                              | 500  | 0.04                            | 0.16                             | 8,650                              | 450   | 0.02                            | 0.1                              |      |
| 2020-220      |                          | 22                       | 10,500                             | 700                | 0.05                            | 0.25                             | 10,500   | 700                | 0.04                            | 0.2                              | 8,200                              | 470  | 0.03                            | 0.12                             | 8,200                              | 440   | 0.018                           | 0.09                             |      |
| 2020-250      |                          | 25                       | 9,000                              | 600                | 0.04                            | 0.2                              | 9,000  | 600                | 0.035                           | 0.17                             | 7,800                              | 440  | 0.025                           | 0.1                              | 7,800                              | 440   | 0.016                           | 0.08                             |      |
| 2020-270      |                          | 27                       | 8,000                              | 530                | 0.037                           | 0.18                             | 8,000  | 530                | 0.032                           | 0.16                             | 7,400                              | 390  | 0.022                           | 0.09                             | 7,400                              | 390   | 0.013                           | 0.06                             |      |
| 2020-300      |                          | 30                       | 7,000                              | 470                | 0.035                           | 0.17                             | 7,000  | 470                | 0.03                            | 0.15                             | 7,000                              | 350  | 0.02                            | 0.08                             | 7,000                              | 350   | 0.01                            | 0.05                             |      |
| 2020-320      |                          | 32                       | 6,750                              | 450                | 0.032                           | 0.16                             | 6,750  | 450                | 0.027                           | 0.13                             | 6,550                              | 300  | 0.017                           | 0.07                             | 6,550                              | 300   | 0.009                           | 0.04                             |      |
| 2020-350      |                          | 35                       | 6,500                              | 430                | 0.03                            | 0.15                             | 6,500  | 430                | 0.025                           | 0.12                             | 6,150                              | 250  | 0.015                           | 0.06                             | 6,150                              | 250   | 0.008                           | 0.04                             |      |
| 2020-400      |                          | 40                       | 6,500                              | 430                | 0.02                            | 0.1                              | 6,500  | 430                | 0.02                            | 0.1                              | 5,250                              | 150  | 0.01                            | 0.05                             | 5,250                              | 150   | 0.006                           | 0.03                             |      |
| 2025-060      |                          | R1.25                    | 6                                  | 27,000             | 2,300                           | 0.28                             | 0.75   | 27,000             | 2,300                           | 0.25                             | 0.5                                | 27,000   | 2,300                           | 0.25                             | 0.75                               | 13,000  | 1,100                           | 0.21                             | 0.63 |
| 2025-080      |                          |                          | 8                                  | 27,000             | 2,300                           | 0.28                             | 0.75   | 27,000             | 2,300                           | 0.25                             | 0.5                                | 27,000   | 2,300                           | 0.25                             | 0.75                               | 13,000  | 1,100                           | 0.21                             | 0.63 |
| 2025-100      | 10                       |                          | 25,000                             | 2,100              | 0.26                            | 0.67                             | 25,000   | 2,100              | 0.23                            | 0.46                             | 24,000                             | 2,200  | 0.2                             | 0.65                             | 11,000                             | 930   | 0.14                            | 0.44                             |      |
| 2025-150      | 15                       |                          | 22,000                             | 1,950              | 0.23                            | 0.59                             | 22,000   | 1,950              | 0.15                            | 0.45                             | 20,000                             | 1,600  | 0.13                            | 0.42                             | 9,000                              | 720   | 0.08                            | 0.32                             |      |
| 2025-200      | 20                       |                          | 11,000                             | 1,150              | 0.14                            | 0.38                             | 11,000   | 1,150              | 0.1                             | 0.3                              | 8,000                              | 600  | 0.06                            | 0.24                             | 7,600                              | 470   | 0.04                            | 0.12                             |      |
| 2025-250      | 25                       |                          | 8,300                              | 1,000              | 0.09                            | 0.27                             | 8,300  | 1,000              | 0.06                            | 0.24                             | 6,200                              | 450  | 0.045                           | 0.18                             | 5,800                              | 400   | 0.03                            | 0.1                              |      |
| 2025-300      | 30                       |                          | 7,000                              | 700                | 0.06                            | 0.24                             | 7,000  | 700                | 0.05                            | 0.2                              | 5,000                              | 380  | 0.03                            | 0.12                             | 4,800                              | 360   | 0.022                           | 0.088                            |      |
| 2025-350      | 35                       |                          | 5,500                              | 530                | 0.04                            | 0.2                              | 5,500  | 530                | 0.035                           | 0.17                             | 4,200                              | 300  | 0.025                           | 0.1                              | 4,200                              | 270   | 0.015                           | 0.06                             |      |
| 2030-060      | R1.5                     |                          | 6                                  | 24,000             | 2,500                           | 0.32                             | 0.9  | 24,000             | 2,500                           | 0.32                             | 0.9                                | 24,000   | 2,500                           | 0.3                              | 0.9                                | 14,000  | 1,400                           | 0.25                             | 0.76 |
| 2030-080      |                          |                          | 8                                  | 24,000             | 2,500                           | 0.32                             | 0.9  | 24,000             | 2,500                           | 0.32                             | 0.9                                | 24,000   | 2,500                           | 0.3                              | 0.9                                | 14,000  | 1,400                           | 0.25                             | 0.76 |
| 2030-100      |                          | 10                       | 22,000                             | 2,300              | 0.28                            | 0.8                              | 22,000   | 2,300              | 0.28                            | 0.8                              | 24,000                             | 2,500  | 0.25                            | 0.75                             | 13,000                             | 1,200   | 0.25                            | 0.76                             |      |
| 2030-120      |                          | 12                       | 22,000                             | 2,300              | 0.28                            | 0.7                              | 22,000   | 2,300              | 0.28                            | 0.7                              | 20,000                             | 2,100  | 0.2                             | 0.65                             | 10,700                             | 1,000   | 0.18                            | 0.54                             |      |
| 2030-140      |                          | 14                       | 20,000                             | 2,100              | 0.24                            | 0.6                              | 20,000   | 2,100              | 0.24                            | 0.6                              | 18,000                             | 1,850  | 0.18                            | 0.5                              | 9,400                              | 800   | 0.16                            | 0.48                             |      |
| 2030-150      |                          | 15                       | 20,000                             | 2,100              | 0.24                            | 0.6                              | 20,000   | 2,100              | 0.24                            | 0.6                              | 17,000                             | 1,750  | 0.17                            | 0.5                              | 9,200                              | 750   | 0.14                            | 0.42                             |      |
| 2030-160      |                          | 16                       | 20,000                             | 2,100              | 0.24                            | 0.6                              | 20,000   | 2,100              | 0.24                            | 0.6                              | 16,000                             | 1,650  | 0.16                            | 0.5                              | 9,000                              | 700   | 0.14                            | 0.42                             |      |
| 2030-180      |                          | 18                       | 17,000                             | 1,950              | 0.22                            | 0.5                              | 17,000   | 1,950              | 0.22                            | 0.5                              | 13,500                             | 1,300  | 0.14                            | 0.43                             | 8,000                              | 650   | 0.12                            | 0.36                             |      |
| 2030-200      |                          | 20                       | 14,000                             | 1,800              | 0.2                             | 0.45                             | 14,000   | 1,800              | 0.2                             | 0.45                             | 11,000                             | 1,000  | 0.12                            | 0.36                             | 7,000                              | 600   | 0.1                             | 0.3                              |      |
| 2030-220      |                          | 22                       | 11,000                             | 1,500              | 0.18                            | 0.38                             | 11,000   | 1,500              | 0.18                            | 0.38                             | 8,700                              | 750  | 0.1                             | 0.3                              | 6,300                              | 490   | 0.08                            | 0.24                             |      |
| 2030-250      |                          | 25                       | 8,000                              | 1,250              | 0.16                            | 0.32                             | 8,000  | 1,250              | 0.16                            | 0.32                             | 6,400                              | 510  | 0.08                            | 0.24                             | 5,600                              | 390   | 0.06                            | 0.18                             |      |
| 2030-270      |                          | 27                       | 7,000                              | 1,100              | 0.13                            | 0.31                             | 7,000  | 1,100              | 0.13                            | 0.31                             | 5,500                              | 480  | 0.06                            | 0.22                             | 4,700                              | 380   | 0.05                            | 0.15                             |      |
| 2030-300      |                          | 30                       | 6,000                              | 1,000              | 0.1                             | 0.3                              | 6,000  | 1,000              | 0.1                             | 0.3                              | 4,600                              | 450  | 0.05                            | 0.2                              | 3,900                              | 370   | 0.04                            | 0.12                             |      |
| 2030-320      |                          | 32                       | 5,700                              | 900                | 0.085                           | 0.29                             | 5,700  | 900                | 0.085                           | 0.29                             | 3,900                              | 380  | 0.045                           | 0.18                             | 3,400                              | 320   | 0.035                           | 0.11                             |      |
| 2030-350      |                          | 35                       | 5,500                              | 800                | 0.07                            | 0.28                             | 5,500  | 800                | 0.07                            | 0.28                             | 3,300                              | 320  | 0.04                            | 0.16                             | 2,900                              | 270   | 0.03                            | 0.1                              |      |
| 2030-400      |                          | 40                       | 4,500                              | 700                | 0.05                            | 0.25                             | 4,500  | 700                | 0.05                            | 0.25                             | 2,700                              | 240  | 0.03                            | 0.12                             | 2,300                              | 210   | 0.02                            | 0.08                             |      |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

# Milling Conditions for CSELB

| WORK MATERIAL |                          |                       | COPPER / ALUMINUM ALLOYS           |                    |                                 |                                  | CARBON STEELS / ALLOY STEELS<br>S45C / S50C / SK / SCM<br>(~325HB) |                    |                                 |                                  | PREHARDENED STEELS<br>NAK80 / STAVAX / HPM38<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>STAVAX / HPM38 / SKD61<br>(45~55HRC) |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                                 | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2035-100      | R1.75                    | 10                    | 24,000                             | 2,700              | 0.35                            | 1                                | 24,000   | 2,700              | 0.35                            | 1                                | 21,000   | 2,400              | 0.35                            | 1                                | 12,000  | 1,700              | 0.3                             | 0.9                              |
| 2035-150      |                          | 15                    | 20,000                             | 2,200              | 0.29                            | 0.8                              | 20,000   | 2,200              | 0.29                            | 0.8                              | 17,000   | 2,000              | 0.25                            | 0.7                              | 9,100   | 1,000              | 0.19                            | 0.57                             |
| 2035-200      |                          | 20                    | 15,000                             | 1,800              | 0.24                            | 0.6                              | 15,000   | 1,800              | 0.24                            | 0.6                              | 12,000   | 1,450              | 0.14                            | 0.45                             | 6,800   | 600                | 0.13                            | 0.39                             |
| 2035-250      |                          | 25                    | 10,000                             | 1,600              | 0.2                             | 0.47                             | 10,000   | 1,600              | 0.2                             | 0.47                             | 8,500  | 950                | 0.12                            | 0.34                             | 6,000   | 540                | 0.09                            | 0.27                             |
| 2035-300      |                          | 30                    | 6,900                              | 1,200              | 0.18                            | 0.36                             | 6,900  | 1,200              | 0.18                            | 0.36                             | 5,500  | 480                | 0.09                            | 0.24                             | 4,800   | 380                | 0.06                            | 0.18                             |
| 2035-400      |                          | 40                    | 4,500                              | 780                | 0.07                            | 0.3                              | 4,500  | 780                | 0.07                            | 0.3                              | 3,000  | 310                | 0.04                            | 0.18                             | 2,800   | 260                | 0.035                           | 0.11                             |
| 2035-450      |                          | 45                    | 3,900                              | 680                | 0.06                            | 0.26                             | 3,900  | 680                | 0.06                            | 0.26                             | 2,300  | 240                | 0.03                            | 0.14                             | 2,000   | 200                | 0.025                           | 0.1                              |
| 2040-080      | R2                       | 8                     | 24,000                             | 2,900              | 0.4                             | 1.2                              | 24,000   | 2,900              | 0.4                             | 1.2                              | 18,000   | 2,400              | 0.4                             | 1.2                              | 11,000  | 2,000              | 0.34                            | 1                                |
| 2040-100      |                          | 10                    | 24,000                             | 2,900              | 0.4                             | 1.2                              | 24,000   | 2,900              | 0.4                             | 1.2                              | 18,000   | 2,400              | 0.4                             | 1.2                              | 11,000  | 2,000              | 0.34                            | 1                                |
| 2040-120      |                          | 12                    | 24,000                             | 2,900              | 0.4                             | 1.2                              | 24,000   | 2,900              | 0.4                             | 1.2                              | 18,000   | 2,400              | 0.4                             | 1.2                              | 9,700   | 1,500              | 0.28                            | 0.85                             |
| 2040-140      |                          | 14                    | 21,000                             | 2,630              | 0.35                            | 1.1                              | 21,000   | 2,630              | 0.35                            | 1.1                              | 15,000   | 2,150              | 0.3                             | 1.1                              | 9,700   | 1,200              | 0.28                            | 0.8                              |
| 2040-150      |                          | 15                    | 19,000                             | 2,350              | 0.32                            | 1                                | 19,000   | 2,350              | 0.32                            | 1                                | 15,000   | 2,150              | 0.3                             | 1                                | 8,800   | 1,100              | 0.24                            | 0.7                              |
| 2040-160      |                          | 16                    | 18,000                             | 2,250              | 0.3                             | 1                                | 18,000   | 2,250              | 0.3                             | 1                                | 15,000   | 2,150              | 0.3                             | 0.9                              | 8,000   | 1,000              | 0.2                             | 0.6                              |
| 2040-180      |                          | 18                    | 16,500                             | 2,050              | 0.3                             | 0.95                             | 16,500   | 2,050              | 0.3                             | 0.95                             | 13,500   | 1,950              | 0.25                            | 0.8                              | 7,500   | 850                | 0.17                            | 0.5                              |
| 2040-200      |                          | 20                    | 15,000                             | 1,900              | 0.3                             | 0.9                              | 15,000   | 1,900              | 0.3                             | 0.9                              | 12,000   | 1,750              | 0.2                             | 0.7                              | 7,000   | 750                | 0.15                            | 0.45                             |
| 2040-220      |                          | 22                    | 13,500                             | 1,700              | 0.27                            | 0.8                              | 13,500   | 1,700              | 0.27                            | 0.8                              | 10,500   | 1,500              | 0.17                            | 0.6                              | 6,500   | 650                | 0.13                            | 0.4                              |
| 2040-250      |                          | 25                    | 12,000                             | 1,550              | 0.25                            | 0.7                              | 12,000   | 1,550              | 0.25                            | 0.7                              | 9,000  | 1,300              | 0.15                            | 0.5                              | 6,000   | 560                | 0.12                            | 0.36                             |
| 2040-270      |                          | 27                    | 9,500                              | 1,450              | 0.22                            | 0.6                              | 9,500  | 1,450              | 0.22                            | 0.6                              | 8,000  | 1,050              | 0.12                            | 0.4                              | 5,500   | 510                | 0.1                             | 0.28                             |
| 2040-300      |                          | 30                    | 7,000                              | 1,400              | 0.2                             | 0.5                              | 7,000  | 1,400              | 0.2                             | 0.5                              | 7,000  | 850                | 0.1                             | 0.3                              | 5,000   | 460                | 0.08                            | 0.2                              |
| 2040-320      |                          | 32                    | 6,500                              | 1,300              | 0.2                             | 0.45                             | 6,500  | 1,300              | 0.2                             | 0.45                             | 5,900  | 650                | 0.1                             | 0.27                             | 4,500   | 410                | 0.075                           | 0.18                             |
| 2040-350      |                          | 35                    | 6,000                              | 1,200              | 0.2                             | 0.4                              | 6,000  | 1,200              | 0.2                             | 0.4                              | 4,800  | 450                | 0.1                             | 0.25                             | 4,000   | 370                | 0.07                            | 0.17                             |
| 2040-400      |                          | 40                    | 4,000                              | 1,000              | 0.11                            | 0.33                             | 4,000  | 1,000              | 0.11                            | 0.33                             | 3,450  | 400                | 0.06                            | 0.24                             | 2,900   | 270                | 0.06                            | 0.15                             |
| 2040-450      |                          | 45                    | 3,800                              | 760                | 0.08                            | 0.32                             | 3,800  | 760                | 0.08                            | 0.32                             | 2,700  | 300                | 0.05                            | 0.2                              | 2,300   | 240                | 0.04                            | 0.12                             |
| 2040-500      |                          | 50                    | 3,400                              | 680                | 0.07                            | 0.28                             | 3,400  | 680                | 0.07                            | 0.28                             | 2,000  | 240                | 0.04                            | 0.16                             | 1,700   | 190                | 0.03                            | 0.12                             |
| 2040-600      | 60                       | 3,000                 | 600                                | 0.05               | 0.2                             | 3,000                            | 600  | 0.05               | 0.2                             | 1,800                            | 220  | 0.03               | 0.12                            | 1,600                            | 170   | 0.02               | 0.08                            |                                  |
| 2050-100      | R2.5                     | 10                    | 18,000                             | 3,000              | 0.5                             | 1.5                              | 18,000   | 3,000              | 0.5                             | 1.5                              | 13,750   | 2,400              | 0.45                            | 1.4                              | 8,800   | 1,800              | 0.42                            | 1.2                              |
| 2050-150      |                          | 15                    | 18,000                             | 3,000              | 0.5                             | 1.5                              | 18,000   | 3,000              | 0.5                             | 1.5                              | 13,750   | 2,400              | 0.45                            | 1.4                              | 7,800   | 1,300              | 0.34                            | 1                                |
| 2050-200      |                          | 20                    | 14,000                             | 2,600              | 0.37                            | 1.2                              | 15,600   | 2,600              | 0.37                            | 1.2                              | 12,000   | 1,800              | 0.36                            | 1.1                              | 6,300   | 830                | 0.27                            | 0.75                             |
| 2050-250      |                          | 25                    | 12,000                             | 2,000              | 0.33                            | 1.1                              | 12,000   | 2,000              | 0.33                            | 1.1                              | 9,600  | 1,350              | 0.25                            | 1                                | 5,700   | 750                | 0.25                            | 0.67                             |
| 2050-300      |                          | 30                    | 9,600                              | 1,800              | 0.31                            | 0.9                              | 9,600  | 1,800              | 0.31                            | 0.9                              | 8,400  | 1,100              | 0.23                            | 0.8                              | 5,000   | 650                | 0.2                             | 0.5                              |
| 2050-350      |                          | 35                    | 8,400                              | 1,700              | 0.3                             | 0.75                             | 8,400  | 1,700              | 0.3                             | 0.75                             | 7,200  | 850                | 0.2                             | 0.6                              | 4,400   | 530                | 0.16                            | 0.33                             |
| 2050-400      |                          | 40                    | 5,500                              | 1,500              | 0.25                            | 0.5                              | 4,800  | 1,500              | 0.25                            | 0.5                              | 3,800  | 440                | 0.13                            | 0.35                             | 3,300   | 390                | 0.09                            | 0.22                             |
| 2050-450      |                          | 45                    | 4,000                              | 1,200              | 0.2                             | 0.42                             | 4,000  | 1,200              | 0.2                             | 0.42                             | 3,300  | 400                | 0.11                            | 0.3                              | 2,800   | 330                | 0.08                            | 0.18                             |
| 2050-500      |                          | 50                    | 3,200                              | 1,000              | 0.16                            | 0.37                             | 3,200  | 1,000              | 0.16                            | 0.37                             | 2,750  | 350                | 0.08                            | 0.27                             | 2,350   | 270                | 0.07                            | 0.15                             |
| 2060-100      |                          | R3                    | 10                                 | 16,000             | 3,100                           | 0.6                              | 1.8  | 16,000             | 3,100                           | 0.6                              | 1.8  | 11,000             | 2,310                           | 0.55                             | 1.7   | 7,500              | 1,800                           | 0.5                              |
| 2060-150      | 15                       |                       | 16,000                             | 3,100              | 0.6                             | 1.8                              | 16,000   | 3,100              | 0.6                             | 1.8                              | 11,000   | 2,310              | 0.55                            | 1.7                              | 7,500   | 1,800              | 0.5                             | 1.5                              |
| 2060-180      | 18                       |                       | 16,000                             | 3,100              | 0.6                             | 1.8                              | 16,000   | 3,100              | 0.6                             | 1.8                              | 11,000   | 2,310              | 0.55                            | 1.7                              | 7,000   | 1,500              | 0.45                            | 1.45                             |
| 2060-200      | 20                       |                       | 16,000                             | 3,100              | 0.6                             | 1.8                              | 16,000   | 3,100              | 0.6                             | 1.8                              | 11,000   | 2,310              | 0.55                            | 1.7                              | 6,500   | 1,300              | 0.4                             | 1.4                              |
| 2060-220      | 22                       |                       | 14,500                             | 2,850              | 0.52                            | 1.6                              | 14,500   | 2,850              | 0.52                            | 1.6                              | 10,500   | 2,050              | 0.47                            | 1.5                              | 5,900   | 1,050              | 0.36                            | 1.1                              |
| 2060-250      | 25                       |                       | 13,000                             | 2,600              | 0.45                            | 1.5                              | 13,000   | 2,600              | 0.45                            | 1.5                              | 10,000   | 1,800              | 0.4                             | 1.3                              | 5,300   | 840                | 0.32                            | 0.9                              |
| 2060-270      | 27                       |                       | 11,500                             | 2,350              | 0.42                            | 1.4                              | 11,500   | 2,350              | 0.42                            | 1.4                              | 9,000  | 1,550              | 0.35                            | 1.2                              | 5,000   | 790                | 0.31                            | 0.85                             |
| 2060-300      | 30                       |                       | 10,000                             | 2,100              | 0.4                             | 1.3                              | 10,000   | 2,100              | 0.4                             | 1.3                              | 8,000  | 1,350              | 0.3                             | 1.1                              | 4,700   | 750                | 0.3                             | 0.8                              |
| 2060-320      | 32                       |                       | 9,000                              | 1,950              | 0.39                            | 1.2                              | 9,000  | 1,950              | 0.39                            | 1.2                              | 7,500  | 1,200              | 0.28                            | 1                                | 4,400   | 710                | 0.27                            | 0.7                              |
| 2060-350      | 35                       |                       | 8,000                              | 1,800              | 0.38                            | 1.1                              | 8,000  | 1,800              | 0.38                            | 1.1                              | 7,000  | 1,100              | 0.26                            | 0.9                              | 4,200   | 670                | 0.25                            | 0.6                              |
| 2060-400      | 40                       |                       | 7,000                              | 1,800              | 0.36                            | 0.9                              | 7,000  | 1,800              | 0.36                            | 0.9                              | 6,000  | 900                | 0.23                            | 0.75                             | 3,700   | 550                | 0.2                             | 0.4                              |
| 2060-450      | 45                       |                       | 5,800                              | 1,700              | 0.33                            | 0.75                             | 5,800  | 1,700              | 0.33                            | 0.75                             | 4,600  | 670                | 0.19                            | 0.6                              | 3,200   | 470                | 0.15                            | 0.3                              |
| 2060-500      | 50                       |                       | 4,000                              | 1,500              | 0.3                             | 0.6                              | 4,000  | 1,500              | 0.3                             | 0.6                              | 3,200  | 450                | 0.15                            | 0.4                              | 2,800   | 400                | 0.1                             | 0.2                              |
| 2060-600      | 60                       |                       | 2,700                              | 1,000              | 0.21                            | 0.42                             | 2,700  | 1,000              | 0.21                            | 0.42                             | 2,300  | 320                | 0.1                             | 0.3                              | 1,950   | 270                | 0.08                            | 0.16                             |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball

Taper Neck Ball

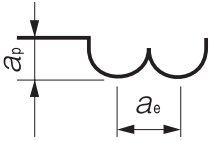
Taper

Barrel

Spiral V Cutter

Drill

Technical Data



**Note:**

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machines maximum speed, or when the tool is chattering and heats up to a red color.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend wet coolant for Copper.

∅3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.2~R3

**DCLB**



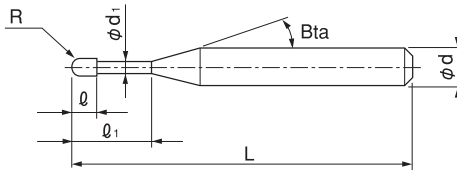
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           | ○               | ★        | ○      | ○        | ●                     |                 |                       |                  | ○                                     |

**Features**

**Diamond coated 2 flute long neck ball end mills for Graphite Electrodes.**

**A highly adhesive coating base, offers long tool life and excellent wear resistance.**



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 68 models

Unit (mm)

| Model Number   | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |       |        |       |       |
|----------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-------|--------|-------|-------|
|                |                       |                        |                   |                          |                       |                  |                         |                          | 30°                                 | 1°    | 1° 30' | 2°    | 3°    |
| DCLB 2004-0020 | R0.2                  | 2                      | 0.32              | 0.37                     | 16°                   | 45               | 4                       | 13,000                   | 2.24                                | 2.41  | 2.54   | 2.65  | 2.85  |
| DCLB 2004-0030 |                       | 3                      |                   |                          |                       | 45               | 4                       | 13,000                   | 3.33                                | 3.52  | 3.67   | 3.80  | 4.08  |
| DCLB 2004-0040 |                       | 4                      |                   |                          |                       | 45               | 4                       | 13,000                   | 4.39                                | 4.61  | 4.78   | 4.94  | 5.30  |
| DCLB 2004-0050 |                       | 5                      |                   |                          |                       | 45               | 4                       | 13,000                   | 5.45                                | 5.69  | 5.88   | 6.08  | 6.52  |
| DCLB 2005-0020 | R0.25                 | 2                      | 0.4               | 0.47                     | 16°                   | 45               | 4                       | 13,000                   | 2.29                                | 2.49  | 2.64   | 2.78  | 3.01  |
| DCLB 2005-0030 |                       | 3                      |                   |                          |                       | 45               | 4                       | 13,000                   | 3.39                                | 3.61  | 3.79   | 3.95  | 4.24  |
| DCLB 2005-0060 |                       | 6                      |                   |                          |                       | 45               | 4                       | 13,000                   | 6.59                                | 6.89  | 7.13   | 7.37  | 7.91  |
| DCLB 2005-0100 |                       | 10                     |                   |                          |                       | 45               | 4                       | 13,000                   | 10.78                               | 11.16 | 11.53  | 11.93 | 12.80 |
| DCLB 2006-0020 | R0.3                  | 2                      | 0.48              | 0.57                     | 16°                   | 45               | 4                       | 13,000                   | 2.33                                | 2.55  | 2.73   | 2.89  | 3.16  |
| DCLB 2006-0030 |                       | 3                      |                   |                          |                       | 45               | 4                       | 13,000                   | 3.44                                | 3.70  | 3.90   | 4.08  | 4.40  |
| DCLB 2006-0040 |                       | 4                      |                   |                          |                       | 45               | 4                       | 13,000                   | 4.53                                | 4.82  | 5.05   | 5.24  | 5.62  |
| DCLB 2006-0060 |                       | 6                      |                   |                          |                       | 45               | 4                       | 13,000                   | 6.67                                | 7.01  | 7.28   | 7.52  | 8.07  |
| DCLB 2006-0100 |                       | 10                     |                   |                          |                       | 45               | 4                       | 13,000                   | 10.89                               | 11.31 | 11.68  | 12.08 | 12.96 |
| DCLB 2006-0120 |                       | 12                     |                   |                          |                       | 45               | 4                       | 13,000                   | 12.98                               | 13.44 | 13.88  | 14.36 | 15.41 |
| DCLB 2008-0100 | R0.4                  | 10                     | 0.64              | 0.77                     | 16°                   | 45               | 4                       | 13,000                   | 10.88                               | 11.30 | 11.67  | 12.07 | 12.94 |
| DCLB 2008-0120 |                       | 12                     |                   |                          |                       | 50               | 4                       | 13,000                   | 12.97                               | 13.43 | 13.87  | 14.34 | 15.39 |
| DCLB 2008-0160 |                       | 16                     |                   |                          |                       | 50               | 4                       | 13,000                   | 17.13                               | 17.69 | 18.27  | 18.90 | 20.28 |

| Model Number      | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |                 |                 |                 |
|-------------------|-----------------------|------------------------|-------------------|------------------------|-----------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                   |                       |                        |                   |                        |                       |                  |                         |                          | 30°                                 | 1°              | 1° 30'          | 2°              | 3°              |                 |                 |                 |
| DCLB 2010-0030    | RO.5                  | 3                      | 0.8               | 0.96                   | 16°                   | 45               | 4                       | 13,000                   | 3.45                                | 3.69            | 3.89            | 4.06            | 4.37            |                 |                 |                 |
| DCLB 2010-0050    |                       | 5                      |                   |                        |                       | 45               | 4                       | 13,000                   | 5.61                                | 5.91            | 6.16            | 6.37            | 6.81            |                 |                 |                 |
| DCLB 2010-0060    |                       | 6                      |                   |                        |                       | 45               | 4                       | 13,000                   | 6.67                                | 7.01            | 7.27            | 7.51            | 8.04            |                 |                 |                 |
| DCLB 2010-0080    |                       | 8                      |                   |                        |                       | 45               | 4                       | 13,000                   | 8.79                                | 9.17            | 9.47            | 9.78            | 10.48           |                 |                 |                 |
| DCLB 2010-0100    |                       | 10                     | 1.5               |                        |                       | 60               | 4                       | 13,000                   | 10.89                               | 11.31           | 11.67           | 12.06           | 12.93           |                 |                 |                 |
| DCLB 2010-0100-08 |                       | 10                     | 0.8               |                        |                       | 45               | 4                       | 13,000                   | 10.89                               | 11.31           | 11.67           | 12.06           | 12.93           |                 |                 |                 |
| DCLB 2010-0120    |                       | 12                     |                   |                        |                       | 50               | 4                       | 13,000                   | 12.98                               | 13.44           | 13.87           | 14.34           | 15.38           |                 |                 |                 |
| DCLB 2010-0160    |                       | 16                     |                   |                        |                       | 50               | 4                       | 13,000                   | 17.14                               | 17.70           | 18.27           | 18.89           | 20.27           |                 |                 |                 |
| DCLB 2010-0200    |                       | 20                     |                   |                        |                       | 1.5              | 60                      | 4                        | 13,000                              | 21.28           | 21.95           | 22.68           | 23.45           | 25.17           |                 |                 |
| DCLB 2015-0060    | RO.75                 | 6                      | 1.2               | 1.44                   | 16°                   | 45               | 4                       | 15,000                   | 6.14                                | 6.32            | 6.51            | 6.71            | 7.16            |                 |                 |                 |
| DCLB 2015-0100    |                       | 10                     |                   |                        |                       | 45               | 4                       | 15,000                   | 10.27                               | 10.58           | 10.91           | 11.27           | 12.06           |                 |                 |                 |
| DCLB 2015-0160    |                       | 16                     |                   |                        |                       | 50               | 4                       | 15,000                   | 16.46                               | 16.97           | 17.51           | 18.10           | 19.40           |                 |                 |                 |
| DCLB 2020-0040    | R1                    | 4                      | 1.6               | 1.9                    | 16°                   | 45               | 4                       | 13,000                   | 4.13                                | 4.23            | 4.34            | 4.46            | 4.73            |                 |                 |                 |
| DCLB 2020-0060    |                       | 6                      |                   |                        |                       | 45               | 4                       | 13,000                   | 6.19                                | 6.36            | 6.54            | 6.74            | 7.17            |                 |                 |                 |
| DCLB 2020-0080    |                       | 8                      |                   |                        |                       | 45               | 4                       | 13,000                   | 8.25                                | 8.49            | 8.74            | 9.02            | 9.62            |                 |                 |                 |
| DCLB 2020-0100    |                       | 10                     |                   |                        |                       | 45               | 4                       | 13,000                   | 10.31                               | 10.62           | 10.94           | 11.29           | 12.07           |                 |                 |                 |
| DCLB 2020-0120    |                       | 12                     |                   |                        |                       | 45               | 4                       | 13,000                   | 12.38                               | 12.75           | 13.15           | 13.57           | 14.52           |                 |                 |                 |
| DCLB 2020-0160    |                       | 16                     |                   |                        |                       | 50               | 4                       | 13,000                   | 16.50                               | 17.01           | 17.55           | 18.12           | 19.41           |                 |                 |                 |
| DCLB 2020-0200-16 |                       | 20                     |                   |                        |                       | 60               | 4                       | 13,000                   | 20.63                               | 21.27           | 21.95           | 22.68           | No Interference |                 |                 |                 |
| DCLB 2020-0200    |                       | 20                     | 3                 | 70                     | 4                     | 13,000           | 20.63                   | 21.27                    | 21.95                               | 22.68           | No Interference |                 |                 |                 |                 |                 |
| DCLB 2020-0250    |                       | 25                     | 1.6               | 65                     | 4                     | 13,000           | 25.79                   | 26.59                    | 27.45                               | 28.37           | No Interference |                 |                 |                 |                 |                 |
| DCLB 2020-0250-30 |                       | 25                     | 3                 | 65                     | 4                     | 13,000           | 25.79                   | 26.59                    | 27.45                               | 28.37           | No Interference |                 |                 |                 |                 |                 |
| DCLB 2020-0300-16 |                       | 30                     | 1.6               | 70                     | 4                     | 13,000           | 30.94                   | 31.92                    | 32.95                               | No Interference | No Interference |                 |                 |                 |                 |                 |
| DCLB 2020-0300    |                       | 30                     | 3                 | 70                     | 4                     | 13,000           | 30.94                   | 31.92                    | 32.95                               | No Interference | No Interference |                 |                 |                 |                 |                 |
| DCLB 2020-0350    |                       | 35                     | 1.91              | 16°                    | 1.91                  | 16°              | 70                      | 4                        | 13,000                              | 36.09           | 37.23           | 38.45           | No Interference | No Interference |                 |                 |
| DCLB 2020-0400    |                       | 40                     |                   |                        |                       |                  | 80                      | 4                        | 13,500                              | 41.25           | 42.55           | No Interference | No Interference | No Interference |                 |                 |
| DCLB 2030-0160    |                       | R1.5                   | 16                | 2.4                    | 2.9                   | 16°              | 60                      | 6                        | 15,000                              | 16.49           | 16.98           | 17.50           | 18.06           | 19.30           |                 |                 |
| DCLB 2030-0200    |                       |                        | 20                |                        |                       |                  | 60                      | 6                        | 15,000                              | 20.61           | 21.23           | 21.90           | 22.61           | 24.20           |                 |                 |
| DCLB 2030-0250    |                       |                        | 25                |                        |                       |                  | 70                      | 6                        | 17,000                              | 25.77           | 26.56           | 27.40           | 28.30           | 30.31           |                 |                 |
| DCLB 2030-0300    | 30                    |                        | 4.5               | 80                     |                       |                  | 4                       | 13,500                   | 30.93                               | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| DCLB 2030-0300-S6 | 30                    |                        | 2.4               | 80                     |                       |                  | 6                       | 17,000                   | 30.93                               | 31.88           | 32.90           | 34.00           | No Interference |                 |                 |                 |
| DCLB 2030-0400-S6 | 40                    |                        |                   | 80                     |                       |                  | 6                       | 18,500                   | 41.24                               | 42.53           | 43.91           | No Interference | No Interference |                 |                 |                 |
| DCLB 2030-0400    | 40                    |                        | 4.5               | 80                     |                       |                  | 4                       | 15,000                   | 41.24                               | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| DCLB 2040-0160    | R2                    |                        | 16                | 3.2                    |                       |                  | 3.9                     | 16°                      | 70                                  | 6               | 16,500          | 16.47           | 16.94           | 17.45           | 17.99           | 19.19           |
| DCLB 2040-0200    |                       |                        | 20                |                        |                       |                  |                         |                          | 70                                  | 6               | 16,500          | 20.60           | 21.20           | 21.85           | 22.54           | No Interference |
| DCLB 2040-0250    |                       | 25                     | 70                |                        | 6                     | 16,500           |                         |                          | 25.75                               | 26.53           | 27.35           | 28.24           | No Interference |                 |                 |                 |
| DCLB 2040-0300    |                       | 30                     | 70                |                        | 6                     | 16,500           |                         |                          | 30.91                               | 31.85           | 32.85           | No Interference | No Interference |                 |                 |                 |
| DCLB 2040-0300-60 |                       | 30                     | 6                 |                        | 100                   | 4                |                         |                          | 18,500                              | No Interference | No Interference | No Interference | No Interference | No Interference |                 |                 |
| DCLB 2040-0400-S6 |                       | 40                     | 3.2               | 16°                    | 90                    | 6                |                         | 18,500                   | 41.22                               | 42.50           | No Interference | No Interference | No Interference |                 |                 |                 |
| DCLB 2040-0400    |                       | 40                     | 6                 | 100                    | 4                     | 18,500           |                         | No Interference          | No Interference                     | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| DCLB 2040-0500-S6 |                       | 50                     | 3.2               | 16°                    | 100                   | 6                |                         | 19,800                   | 51.54                               | 53.15           | No Interference | No Interference | No Interference |                 |                 |                 |
| DCLB 2040-0500    |                       | 50                     | 6                 | 100                    | 4                     | 19,000           |                         | No Interference          | No Interference                     | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| DCLB 2040-0600    |                       | 60                     | 3.91              | 100                    | 4                     | 19,000           |                         | No Interference          | No Interference                     | No Interference | No Interference | No Interference |                 |                 |                 |                 |
| DCLB 2050-0200    | R2.5                  | 20                     | 4                 | 4.8                    | 16°                   | 70               | 6                       | 16,500                   | 20.76                               | 21.36           | 21.99           | No Interference | No Interference |                 |                 |                 |
| DCLB 2050-0300    |                       | 30                     |                   |                        |                       | 80               | 6                       | 17,000                   | 31.08                               | 32.00           | No Interference | No Interference | No Interference |                 |                 |                 |
| DCLB 2060-0300    | R3                    | 30                     | 4.8               | 5.7                    | -                     | 80               | 6                       | 17,000                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| DCLB 2060-0400    |                       | 40                     |                   |                        |                       | 100              | 6                       | 19,800                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| DCLB 2060-0500    |                       | 50                     |                   |                        |                       | 120              | 6                       | 19,800                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| DCLB 2060-0600    |                       | 60                     |                   |                        |                       | 120              | 6                       | 23,000                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |                 |                 |                 |
| DCLB 2060-0700    |                       | 70                     |                   |                        |                       | 5.71             | -                       | 120                      | 6                                   | 23,000          | No Interference | No Interference | No Interference | No Interference | No Interference |                 |
| DCLB 2060-0800    |                       | 80                     |                   |                        |                       |                  |                         | 120                      | 6                                   | 25,300          | No Interference | No Interference | No Interference | No Interference | No Interference |                 |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for DCLB

| WORK MATERIAL  |                          |                       | GRAPHITE                           |                    |                                 |                                  |
|----------------|--------------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number   | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2004-0020      | R0.2                     | 2                     | 33,500                             | 1,100              | 0.1                             | 0.04                             |
| 2004-0030      |                          | 3                     | 33,500                             | 1,100              | 0.09                            | 0.04                             |
| 2004-0040      |                          | 4                     | 33,500                             | 1,100              | 0.08                            | 0.04                             |
| 2004-0050      |                          | 5                     | 33,500                             | 1,100              | 0.06                            | 0.04                             |
| 2005-0020      |                          | R0.25                 | 2                                  | 33,500             | 1,200                           | 0.11                             |
| 2005-0030      | 3                        |                       | 33,500                             | 1,200              | 0.1                             | 0.05                             |
| 2005-0060      | 6                        |                       | 33,500                             | 1,200              | 0.07                            | 0.05                             |
| 2005-0100      | 10                       |                       | 33,500                             | 1,200              | 0.03                            | 0.05                             |
| 2006-0020      | R0.3                     | 2                     | 33,500                             | 1,300              | 0.15                            | 0.06                             |
| 2006-0030      |                          | 3                     | 33,500                             | 1,300              | 0.13                            | 0.06                             |
| 2006-0040      |                          | 4                     | 33,500                             | 1,300              | 0.12                            | 0.06                             |
| 2006-0060      |                          | 6                     | 33,500                             | 1,300              | 0.1                             | 0.06                             |
| 2006-0100      |                          | 10                    | 33,500                             | 1,300              | 0.04                            | 0.06                             |
| 2006-0120      | R0.4                     | 12                    | 33,500                             | 1,300              | 0.04                            | 0.06                             |
| 2008-0100      |                          | 10                    | 33,500                             | 1,400              | 0.13                            | 0.08                             |
| 2008-0120      |                          | 12                    | 33,500                             | 1,400              | 0.1                             | 0.08                             |
| 2008-0160      | R0.5                     | 16                    | 33,500                             | 1,400              | 0.08                            | 0.08                             |
| 2010-0030      |                          | 3                     | 33,500                             | 1,500              | 0.2                             | 0.1                              |
| 2010-0050      |                          | 5                     | 33,500                             | 1,500              | 0.19                            | 0.1                              |
| 2010-0060      |                          | 6                     | 33,500                             | 1,500              | 0.19                            | 0.1                              |
| 2010-0080      |                          | 8                     | 33,500                             | 1,500              | 0.18                            | 0.1                              |
| 2010-0100(-08) |                          | 10                    | 33,500                             | 1,500              | 0.16                            | 0.1                              |
| 2010-0120      |                          | 12                    | 33,500                             | 1,500              | 0.15                            | 0.1                              |
| 2010-0160      | R0.75                    | 16                    | 33,500                             | 1,500              | 0.12                            | 0.1                              |
| 2010-0200      |                          | 20                    | 33,500                             | 1,500              | 0.1                             | 0.1                              |
| 2015-0060      |                          | 6                     | 30,000                             | 1,500              | 0.35                            | 0.15                             |
| 2015-0100      |                          | 10                    | 30,000                             | 1,500              | 0.3                             | 0.15                             |
| 2015-0160      | R1                       | 16                    | 30,000                             | 1,500              | 0.25                            | 0.15                             |
| 2020-0040      |                          | 4                     | 27,000                             | 1,500              | 0.5                             | 0.2                              |
| 2020-0060      |                          | 6                     | 27,000                             | 1,500              | 0.49                            | 0.2                              |
| 2020-0080      |                          | 8                     | 27,000                             | 1,500              | 0.48                            | 0.2                              |
| 2020-0100      |                          | 10                    | 27,000                             | 1,500              | 0.46                            | 0.2                              |
| 2020-0120      |                          | 12                    | 27,000                             | 1,500              | 0.43                            | 0.2                              |
| 2020-0160      |                          | 16                    | 27,000                             | 1,500              | 0.38                            | 0.2                              |
| 2020-0200(-16) |                          | 20                    | 27,000                             | 1,500              | 0.24                            | 0.2                              |
| 2020-0250(-30) |                          | 25                    | 27,000                             | 1,500              | 0.19                            | 0.2                              |
| 2020-0300(-16) |                          | 30                    | 27,000                             | 1,500              | 0.12                            | 0.2                              |
| 2020-0350      | 35                       | 27,000                | 1,500                              | 0.11               | 0.2                             |                                  |
| 2020-0400      | 40                       | 27,000                | 1,500                              | 0.09               | 0.2                             |                                  |

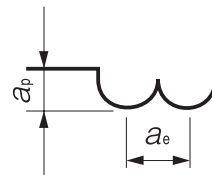
- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for DCLB

| WORK MATERIAL  |                          |                       | GRAPHITE                           |                    |                        |                         |      |
|----------------|--------------------------|-----------------------|------------------------------------|--------------------|------------------------|-------------------------|------|
| Model Number   | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |      |
| 2030-0160      | R1.5                     | 16                    | 18,000                             | 1,650              | 0.5                    | 0.45                    |      |
| 2030-0200      |                          | 20                    | 18,000                             | 1,650              | 0.44                   | 0.45                    |      |
| 2030-0250      |                          | 25                    | 18,000                             | 1,650              | 0.36                   | 0.45                    |      |
| 2030-0300(-S6) |                          | 30                    | 18,000                             | 1,650              | 0.3                    | 0.45                    |      |
| 2030-0400(-S6) |                          | 40                    | 18,000                             | 1,650              | 0.2                    | 0.45                    |      |
| 2040-0160      |                          | R2                    | 16                                 | 13,500             | 1,750                  | 0.7                     | 0.6  |
| 2040-0200      | 20                       |                       | 13,500                             | 1,750              | 0.65                   | 0.6                     |      |
| 2040-0250      | 25                       |                       | 13,500                             | 1,750              | 0.55                   | 0.6                     |      |
| 2040-0300      | 30                       |                       | 13,500                             | 1,750              | 0.5                    | 0.6                     |      |
| 2040-0300(-60) | 30                       |                       | 13,500                             | 1,750              | 0.5                    | 0.6                     |      |
| 2040-0400(-S6) | 40                       |                       | 13,500                             | 1,750              | 0.4                    | 0.6                     |      |
| 2040-0500(-S6) | 50                       |                       | 13,500                             | 1,750              | 0.24                   | 0.6                     |      |
| 2040-0600      | 60                       |                       | 13,500                             | 1,750              | 0.18                   | 0.6                     |      |
| 2050-0200      | R2.5                     |                       | 20                                 | 10,800             | 1,600                  | 0.8                     | 0.75 |
| 2050-0300      |                          |                       | 30                                 | 10,800             | 1,600                  | 0.6                     | 0.75 |
| 2060-0300      | R3                       | 30                    | 9,000                              | 1,400              | 0.9                    | 0.9                     |      |
| 2060-0400      |                          | 40                    | 9,000                              | 1,400              | 0.75                   | 0.9                     |      |
| 2060-0500      |                          | 50                    | 9,000                              | 1,400              | 0.6                    | 0.9                     |      |
| 2060-0600      |                          | 60                    | 9,000                              | 1,400              | 0.51                   | 0.9                     |      |
| 2060-0700      |                          | 70                    | 9,000                              | 1,400              | 0.4                    | 0.9                     |      |
| 2060-0800      |                          | 80                    | 9,000                              | 1,400              | 0.23                   | 0.9                     |      |

## Note:

- Use a milling machine dedicated for Graphite.
- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Recommend air blow for Graphite.



Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.05~R3

# DLCLB

Super  
MG

DLC

30°

R  
±0.002  
R0.05~R0.2

R  
±0.003  
R0.25~R2

R  
±0.004  
R3

Shank Dia  
0/-0.004

Back Taper  
Geometry

Back taper geometry does not apply to R0.15 or below.

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material |              |                    |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|---------------|--------------|--------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels | Alloy Steels | Prehardened Steels | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
| S45C          | SK / SCM     | NAK                | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| S55C          | SUS          | HPM                |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|               |              |                    |                 |        |        |        |        |           | ●               |          | ★      |          |                       |                 |                       |                  |                                       |

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

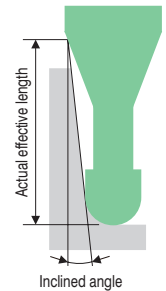
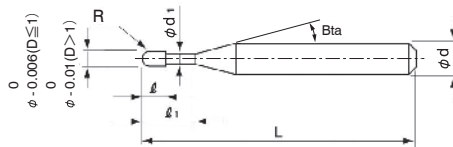
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Label Sample



#001 φD0.597 R+0.001/-0.001

Diameter and Ball Radius accuracy measurements are printed on the label to support High Precision milling.

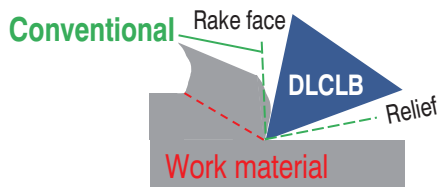
The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 71 models

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-----------------|-----------------------|------------------------|-------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| DLCLB 2001-003  | R0.05                 | 0.3                    | 0.08              | 0.095                    | 11°                   | 45               | 4                       | 10,600                   |
| DLCLB 2001-005  |                       | 0.5                    |                   |                          |                       |                  |                         | 11,000                   |
| DLCLB 20015-003 | R0.075                | 0.3                    | 0.12              | 0.14                     | 11°                   | 45               | 4                       | 11,700                   |
| DLCLB 20015-005 |                       | 0.5                    |                   |                          |                       |                  |                         | 12,400                   |
| DLCLB 20015-010 |                       | 1                      |                   |                          |                       |                  |                         | 12,900                   |
| DLCLB 2002-003  |                       | 0.3                    |                   |                          |                       |                  |                         | 0.16                     |
| DLCLB 2002-005  | 0.5                   | 8,500                  |                   |                          |                       |                  |                         |                          |
| DLCLB 2002-010  | 1                     | 8,900                  |                   |                          |                       |                  |                         |                          |
| DLCLB 2002-015  | 1.5                   | 9,200                  |                   |                          |                       |                  |                         |                          |

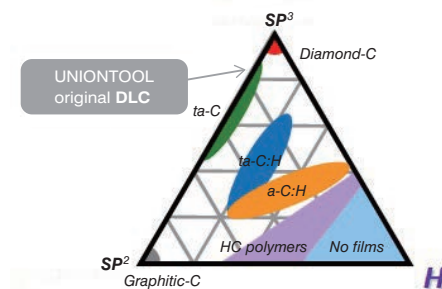


## Best wedge angle for copper milling



Wedge angle  
**DLCLB < Conventional**

## Near Diamond hardness DLC coating



The hard DLC was developed by our in-house coating furnace.

## High accuracy

Tolerance settings that enable high accuracy milling (mm)

|                          |               |             |             |
|--------------------------|---------------|-------------|-------------|
| Ball Radius Accuracy     | $D \leq R0.5$ | $D > R0.5$  |             |
| Diameter Tolerance       | 0/-0.006      | 0/-0.01     |             |
| Ball Radius Accuracy     | R0.05 ~ R0.2  | R0.25 ~ R2  | R3          |
| Radius Accuracy          | $\pm 0.002$   | $\pm 0.003$ | $\pm 0.004$ |
| Shank Diameter Tolerance | 0/-0.004      |             |             |

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Effective Length by Inclined Angles |      |        |      |      |
|-----------------|-----------------------|------------------------|-------------------------------------|------|--------|------|------|
|                 |                       |                        | 30'                                 | 1°   | 1° 30' | 2°   | 3°   |
| DLCLB 2001-003  | R0.05                 | 0.3                    | 0.34                                | 0.36 | 0.39   | 0.41 | 0.46 |
| DLCLB 2001-005  |                       | 0.5                    | 0.55                                | 0.59 | 0.62   | 0.65 | 0.73 |
| DLCLB 20015-003 | R0.075                | 0.3                    | 0.36                                | 0.38 | 0.40   | 0.42 | 0.47 |
| DLCLB 20015-005 |                       | 0.5                    | 0.57                                | 0.60 | 0.63   | 0.66 | 0.74 |
| DLCLB 20015-010 |                       | 1                      | 1.09                                | 1.15 | 1.21   | 1.27 | 1.43 |
| DLCLB 2002-003  |                       | R0.1                   | 0.3                                 | 0.41 | 0.43   | 0.45 | 0.47 |
| DLCLB 2002-005  | 0.5                   |                        | 0.62                                | 0.65 | 0.68   | 0.72 | 0.80 |
| DLCLB 2002-010  | 1                     |                        | 1.14                                | 1.20 | 1.26   | 1.33 | 1.49 |
| DLCLB 2002-015  | 1.5                   |                        | 1.67                                | 1.75 | 1.84   | 1.94 | 2.17 |

Next Page →

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## 2 Flutes DLC for Copper Electrode

| Model Number   | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bfa | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| DLCLB 2003-006 | RO.15                 | 0.6                       | 0.24                 | 0.29                     | 11°                   | 45               | 4                       | 8,900                    |
| DLCLB 2003-010 |                       | 1                         |                      |                          |                       | 45               |                         | 8,900                    |
| DLCLB 2003-015 |                       | 1.5                       |                      |                          |                       | 45               |                         | 9,200                    |
| DLCLB 2003-020 |                       | 2                         |                      |                          |                       | 45               |                         | 9,600                    |
| DLCLB 2004-010 | RO.2                  | 1                         | 0.32                 | 0.39                     | 11°                   | 45               | 4                       | 7,700                    |
| DLCLB 2004-020 |                       | 2                         |                      |                          |                       | 45               |                         | 7,900                    |
| DLCLB 2004-030 |                       | 3                         |                      |                          |                       | 45               |                         | 8,000                    |
| DLCLB 2004-040 |                       | 4                         |                      |                          |                       | 45               |                         | 8,200                    |
| DLCLB 2005-010 | RO.25                 | 1                         | 0.4                  | 0.49                     | 11°                   | 45               | 4                       | 7,600                    |
| DLCLB 2005-020 |                       | 2                         |                      |                          |                       | 45               |                         | 7,600                    |
| DLCLB 2005-030 |                       | 3                         |                      |                          |                       | 45               |                         | 7,700                    |
| DLCLB 2005-040 |                       | 4                         |                      |                          |                       | 45               |                         | 7,900                    |
| DLCLB 2005-050 |                       | 5                         |                      |                          |                       | 45               |                         | 8,000                    |
| DLCLB 2006-010 | RO.3                  | 1                         | 0.48                 | 0.59                     | 11°                   | 45               | 4                       | 5,900                    |
| DLCLB 2006-020 |                       | 2                         |                      |                          |                       | 45               |                         | 5,900                    |
| DLCLB 2006-030 |                       | 3                         |                      |                          |                       | 45               |                         | 6,100                    |
| DLCLB 2006-040 |                       | 4                         |                      |                          |                       | 45               |                         | 6,200                    |
| DLCLB 2006-050 |                       | 5                         |                      |                          |                       | 45               |                         | 6,400                    |
| DLCLB 2006-060 |                       | 6                         |                      |                          |                       | 45               |                         | 6,500                    |
| DLCLB 2008-020 | RO.4                  | 2                         | 0.64                 | 0.79                     | 11°                   | 45               | 4                       | 6,100                    |
| DLCLB 2008-030 |                       | 3                         |                      |                          |                       | 45               |                         | 6,100                    |
| DLCLB 2008-040 |                       | 4                         |                      |                          |                       | 45               |                         | 6,200                    |
| DLCLB 2008-060 |                       | 6                         |                      |                          |                       | 45               |                         | 6,400                    |
| DLCLB 2008-080 |                       | 8                         |                      |                          |                       | 45               |                         | 6,500                    |
| DLCLB 2010-020 | RO.5                  | 2                         | 0.8                  | 0.98                     | 11°                   | 45               | 4                       | 5,800                    |
| DLCLB 2010-030 |                       | 3                         |                      |                          |                       | 45               |                         | 5,800                    |
| DLCLB 2010-040 |                       | 4                         |                      |                          |                       | 45               |                         | 5,800                    |
| DLCLB 2010-050 |                       | 5                         |                      |                          |                       | 45               |                         | 5,900                    |
| DLCLB 2010-060 |                       | 6                         |                      |                          |                       | 45               |                         | 5,900                    |
| DLCLB 2010-080 |                       | 8                         |                      |                          |                       | 45               |                         | 6,200                    |
| DLCLB 2010-100 |                       | 10                        |                      |                          |                       | 45               |                         | 6,200                    |
| DLCLB 2010-120 |                       | 12                        |                      |                          |                       | 45               |                         | 6,200                    |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

| Model Number   | Radius of Ball Nose R | Effective Length $l_1$ | Effective Length by Inclined Angles |       |        |       |       |
|----------------|-----------------------|------------------------|-------------------------------------|-------|--------|-------|-------|
|                |                       |                        | 30'                                 | 1°    | 1° 30' | 2°    | 3°    |
| DLCLB 2003-006 | RO.15                 | 0.6                    | 0.72                                | 0.75  | 0.79   | 0.83  | 0.92  |
| DLCLB 2003-010 |                       | 1                      | 1.14                                | 1.19  | 1.25   | 1.32  | 1.47  |
| DLCLB 2003-015 |                       | 1.5                    | 1.67                                | 1.74  | 1.83   | 1.93  | 2.15  |
| DLCLB 2003-020 |                       | 2                      | 2.19                                | 2.29  | 2.41   | 2.53  | 2.84  |
| DLCLB 2004-010 | RO.2                  | 1                      | 1.14                                | 1.19  | 1.24   | 1.30  | 1.45  |
| DLCLB 2004-020 |                       | 2                      | 2.19                                | 2.29  | 2.40   | 2.52  | 2.82  |
| DLCLB 2004-030 |                       | 3                      | 3.23                                | 3.39  | 3.56   | 3.74  | 4.19  |
| DLCLB 2004-040 |                       | 4                      | 4.28                                | 4.49  | 4.71   | 4.96  | 5.56  |
| DLCLB 2005-010 | RO.25                 | 1                      | 1.14                                | 1.18  | 1.24   | 1.29  | 1.43  |
| DLCLB 2005-020 |                       | 2                      | 2.18                                | 2.28  | 2.39   | 2.51  | 2.80  |
| DLCLB 2005-030 |                       | 3                      | 3.23                                | 3.38  | 3.55   | 3.73  | 4.17  |
| DLCLB 2005-040 |                       | 4                      | 4.28                                | 4.48  | 4.70   | 4.95  | 5.54  |
| DLCLB 2005-050 |                       | 5                      | 5.33                                | 5.58  | 5.86   | 6.17  | 6.91  |
| DLCLB 2006-010 | RO.3                  | 1                      | 1.14                                | 1.18  | 1.23   | 1.28  | 1.41  |
| DLCLB 2006-020 |                       | 2                      | 2.18                                | 2.28  | 2.38   | 2.50  | 2.78  |
| DLCLB 2006-030 |                       | 3                      | 3.23                                | 3.38  | 3.54   | 3.72  | 4.15  |
| DLCLB 2006-040 |                       | 4                      | 4.28                                | 4.48  | 4.70   | 4.94  | 5.52  |
| DLCLB 2006-050 |                       | 5                      | 5.32                                | 5.57  | 5.85   | 6.16  | 6.89  |
| DLCLB 2006-060 |                       | 6                      | 6.37                                | 6.67  | 7.01   | 7.38  | 8.26  |
| DLCLB 2008-020 | RO.4                  | 2                      | 2.18                                | 2.27  | 2.37   | 2.48  | 2.75  |
| DLCLB 2008-030 |                       | 3                      | 3.22                                | 3.37  | 3.52   | 3.70  | 4.12  |
| DLCLB 2008-040 |                       | 4                      | 4.27                                | 4.47  | 4.68   | 4.92  | 5.48  |
| DLCLB 2008-060 |                       | 6                      | 6.37                                | 6.66  | 6.99   | 7.36  | 8.22  |
| DLCLB 2008-080 |                       | 8                      | 8.46                                | 8.86  | 9.30   | 9.79  | 10.96 |
| DLCLB 2010-020 | RO.5                  | 2                      | 2.19                                | 2.28  | 2.37   | 2.48  | 2.73  |
| DLCLB 2010-030 |                       | 3                      | 3.24                                | 3.37  | 3.53   | 3.70  | 4.10  |
| DLCLB 2010-040 |                       | 4                      | 4.28                                | 4.47  | 4.68   | 4.92  | 5.47  |
| DLCLB 2010-050 |                       | 5                      | 5.33                                | 5.57  | 5.84   | 6.14  | 6.84  |
| DLCLB 2010-060 |                       | 6                      | 6.38                                | 6.67  | 6.99   | 7.35  | 8.21  |
| DLCLB 2010-080 |                       | 8                      | 8.47                                | 8.87  | 9.31   | 9.79  | 10.95 |
| DLCLB 2010-100 |                       | 10                     | 10.57                               | 11.07 | 11.62  | 12.23 | 13.68 |
| DLCLB 2010-120 |                       | 12                     | 12.66                               | 13.26 | 13.93  | 14.67 | 16.42 |

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## 2 Flutes DLC for Copper Electrode

| Model Number   | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle B <sub>ta</sub> | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-----------------------|---------------------------|----------------------|--------------------------|-----------------------------------|------------------|-------------------------|--------------------------|
| DLCLB 2015-040 | R0.75                 | 4                         | 1.2                  | 1.47                     | 11°                               | 45               | 4                       | 5,900                    |
| DLCLB 2015-060 |                       | 6                         |                      |                          |                                   | 45               |                         |                          |
| DLCLB 2015-120 |                       | 12                        |                      |                          |                                   | 50               |                         |                          |
| DLCLB 2015-180 |                       | 18                        |                      |                          |                                   | 55               |                         |                          |
| DLCLB 2020-040 | R1                    | 4                         | 1.6                  | 1.98                     | 11°                               | 45               | 4                       | 6,100                    |
| DLCLB 2020-060 |                       | 6                         |                      |                          |                                   | 45               |                         |                          |
| DLCLB 2020-080 |                       | 8                         |                      |                          |                                   | 45               |                         |                          |
| DLCLB 2020-100 |                       | 10                        |                      |                          |                                   | 45               |                         |                          |
| DLCLB 2020-120 |                       | 12                        |                      |                          |                                   | 50               |                         |                          |
| DLCLB 2020-140 |                       | 14                        |                      |                          |                                   | 50               |                         |                          |
| DLCLB 2020-160 |                       | 16                        |                      |                          |                                   | 50               |                         |                          |
| DLCLB 2020-200 |                       | 20                        |                      |                          |                                   | 55               |                         |                          |
| DLCLB 2020-250 |                       | 25                        |                      |                          |                                   | 65               |                         |                          |
| DLCLB 2030-100 |                       | R1.5                      |                      |                          |                                   | 10               |                         |                          |
| DLCLB 2030-120 | 12                    |                           | 60                   |                          |                                   |                  |                         |                          |
| DLCLB 2030-140 | 14                    |                           | 60                   |                          |                                   |                  |                         |                          |
| DLCLB 2030-160 | 16                    |                           | 60                   |                          |                                   |                  |                         |                          |
| DLCLB 2030-200 | 20                    |                           | 70                   |                          |                                   |                  |                         |                          |
| DLCLB 2030-250 | 25                    |                           | 70                   |                          |                                   |                  |                         |                          |
| DLCLB 2030-300 | 30                    |                           | 70                   |                          |                                   |                  |                         |                          |
| DLCLB 2040-100 | R2                    |                           | 10                   | 3.2                      | 3.95                              | 11°              | 70                      | 6                        |
| DLCLB 2040-150 |                       | 15                        | 70                   |                          |                                   |                  |                         |                          |
| DLCLB 2040-200 |                       | 20                        | 70                   |                          |                                   |                  |                         |                          |
| DLCLB 2040-250 |                       | 25                        | 70                   |                          |                                   |                  |                         |                          |
| DLCLB 2040-300 |                       | 30                        | 70                   |                          |                                   |                  |                         |                          |
| DLCLB 2040-400 |                       | 40                        | 80                   |                          |                                   |                  |                         |                          |
| DLCLB 2060-100 | R3                    | 10                        | 4.8                  | 5.95                     | —                                 | 80               | 6                       | 9,500                    |
| DLCLB 2060-150 |                       | 15                        |                      |                          |                                   | 80               |                         |                          |
| DLCLB 2060-200 |                       | 20                        |                      |                          |                                   | 80               |                         |                          |
| DLCLB 2060-300 |                       | 30                        |                      |                          |                                   | 80               |                         |                          |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Unit (mm)

| Model Number   | Radius of Ball Nose R | Effective Length $l_1$ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|----------------|-----------------------|------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|                |                       |                        | 30'                                 | 1°              | 1° 30'          | 2°              | 3°              |
| DLCLB 2015-040 | R0.75                 | 4                      | 4.21                                | 4.39            | 4.58            | 4.80            | 5.31            |
| DLCLB 2015-060 |                       | 6                      | 6.31                                | 6.59            | 6.89            | 7.23            | 8.04            |
| DLCLB 2015-120 |                       | 12                     | 12.59                               | 13.18           | 13.83           | 14.55           | 16.26           |
| DLCLB 2015-180 |                       | 18                     | 18.87                               | 19.77           | 20.76           | 21.86           | 24.47           |
| DLCLB 2020-040 | R1                    | 4                      | 4.18                                | 4.34            | 4.51            | 4.71            | 5.18            |
| DLCLB 2020-060 |                       | 6                      | 6.27                                | 6.53            | 6.82            | 7.15            | 7.92            |
| DLCLB 2020-080 |                       | 8                      | 8.36                                | 8.73            | 9.14            | 9.59            | 10.66           |
| DLCLB 2020-100 |                       | 10                     | 10.46                               | 10.93           | 11.45           | 12.02           | 13.39           |
| DLCLB 2020-120 |                       | 12                     | 12.55                               | 13.12           | 13.76           | 14.46           | 16.13           |
| DLCLB 2020-140 |                       | 14                     | 14.65                               | 15.32           | 16.07           | 16.90           | 18.87           |
| DLCLB 2020-160 |                       | 16                     | 16.74                               | 17.52           | 18.38           | 19.34           | No Interference |
| DLCLB 2020-200 |                       | 20                     | 20.93                               | 21.91           | 23.00           | 24.21           | No Interference |
| DLCLB 2020-250 |                       | 25                     | 26.16                               | 27.41           | 28.78           | No Interference | No Interference |
| DLCLB 2030-100 |                       | R1.5                   | 10                                  | 10.51           | 10.96           | 11.46           | 12.01           |
| DLCLB 2030-120 | 12                    |                        | 12.61                               | 13.16           | 13.77           | 14.45           | 16.06           |
| DLCLB 2030-140 | 14                    |                        | 14.70                               | 15.36           | 16.08           | 16.89           | 18.80           |
| DLCLB 2030-160 | 16                    |                        | 16.80                               | 17.56           | 18.39           | 19.32           | 21.54           |
| DLCLB 2030-200 | 20                    |                        | 20.98                               | 21.95           | 23.02           | 24.20           | 27.01           |
| DLCLB 2030-250 | 25                    |                        | 26.22                               | 27.44           | 28.79           | 30.30           | No Interference |
| DLCLB 2030-300 | 30                    |                        | 31.45                               | 32.94           | 34.57           | 36.39           | No Interference |
| DLCLB 2040-100 | R2                    | 10                     | 10.49                               | 10.91           | 11.38           | 11.90           | 13.14           |
| DLCLB 2040-150 |                       | 15                     | 15.73                               | 16.41           | 17.16           | 18.00           | 19.99           |
| DLCLB 2040-200 |                       | 20                     | 20.96                               | 21.90           | 22.94           | 24.09           | No Interference |
| DLCLB 2040-250 |                       | 25                     | 26.20                               | 27.39           | 28.72           | 30.19           | No Interference |
| DLCLB 2040-300 |                       | 30                     | 31.43                               | 32.89           | 34.50           | No Interference | No Interference |
| DLCLB 2040-400 |                       | 40                     | 41.90                               | 43.87           | No Interference | No Interference | No Interference |
| DLCLB 2060-100 | R3                    | 10                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| DLCLB 2060-150 |                       | 15                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| DLCLB 2060-200 |                       | 20                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| DLCLB 2060-300 |                       | 30                     | No Interference                     | No Interference | No Interference | No Interference | No Interference |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
Radius  
Taper Neck  
RadiusBall / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
BallTaper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for DLCLB

| WORK MATERIAL |                          |                       | COPPER / ALUMINUM ALLOYS           |                    |                                 |                                  | TUNGSTEN COPPER                    |                    |                                 |                                  |
|---------------|--------------------------|-----------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|------------------------------------|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 2001-003      | R0.05                    | 0.3                   | 43,600                             | 220                | 0.01                            | 0.01                             | 32,700                             | 160                | 0.008                           | 0.008                            |
| 2001-005      |                          | 0.5                   | 43,600                             | 160                | 0.007                           | 0.007                            | 32,700                             | 110                | 0.005                           | 0.005                            |
| 20015-003     | R0.075                   | 0.3                   | 43,600                             | 250                | 0.015                           | 0.02                             | 32,700                             | 190                | 0.012                           | 0.016                            |
| 20015-005     |                          | 0.5                   | 43,600                             | 220                | 0.015                           | 0.02                             | 32,700                             | 150                | 0.012                           | 0.016                            |
| 20015-010     |                          | 1                     | 43,600                             | 160                | 0.007                           | 0.01                             | 32,700                             | 120                | 0.006                           | 0.008                            |
| 2002-003      | R0.1                     | 0.3                   | 43,600                             | 550                | 0.025                           | 0.05                             | 32,700                             | 380                | 0.02                            | 0.04                             |
| 2002-005      |                          | 0.5                   | 43,600                             | 550                | 0.025                           | 0.05                             | 32,700                             | 380                | 0.02                            | 0.04                             |
| 2002-010      |                          | 1                     | 43,600                             | 440                | 0.02                            | 0.04                             | 32,700                             | 270                | 0.015                           | 0.03                             |
| 2002-015      |                          | 1.5                   | 32,900                             | 250                | 0.015                           | 0.03                             | 24,700                             | 120                | 0.008                           | 0.02                             |
| 2003-006      | R0.15                    | 0.6                   | 43,600                             | 760                | 0.03                            | 0.07                             | 32,700                             | 550                | 0.03                            | 0.07                             |
| 2003-010      |                          | 1                     | 43,600                             | 760                | 0.03                            | 0.07                             | 32,700                             | 550                | 0.03                            | 0.07                             |
| 2003-015      |                          | 1.5                   | 43,600                             | 550                | 0.025                           | 0.05                             | 32,700                             | 290                | 0.02                            | 0.05                             |
| 2003-020      |                          | 2                     | 39,200                             | 390                | 0.02                            | 0.03                             | 29,400                             | 200                | 0.01                            | 0.02                             |
| 2004-010      | R0.2                     | 1                     | 43,600                             | 1,090              | 0.05                            | 0.1                              | 32,700                             | 760                | 0.04                            | 0.08                             |
| 2004-020      |                          | 2                     | 43,600                             | 650                | 0.035                           | 0.06                             | 32,700                             | 380                | 0.02                            | 0.05                             |
| 2004-030      |                          | 3                     | 35,000                             | 470                | 0.02                            | 0.04                             | 29,200                             | 230                | 0.01                            | 0.03                             |
| 2004-040      |                          | 4                     | 27,300                             | 270                | 0.008                           | 0.015                            | 19,600                             | 110                | 0.005                           | 0.01                             |
| 2005-010      | R0.25                    | 1                     | 43,600                             | 1,420              | 0.08                            | 0.15                             | 32,700                             | 890                | 0.08                            | 0.15                             |
| 2005-020      |                          | 2                     | 43,600                             | 870                | 0.08                            | 0.15                             | 32,700                             | 550                | 0.08                            | 0.15                             |
| 2005-030      |                          | 3                     | 38,200                             | 650                | 0.06                            | 0.1                              | 29,500                             | 390                | 0.06                            | 0.08                             |
| 2005-040      |                          | 4                     | 32,700                             | 440                | 0.04                            | 0.08                             | 24,000                             | 220                | 0.025                           | 0.05                             |
| 2005-050      |                          | 5                     | 27,300                             | 330                | 0.02                            | 0.04                             | 19,600                             | 160                | 0.01                            | 0.02                             |
| 2006-010      | R0.3                     | 1                     | 43,600                             | 1,870              | 0.12                            | 0.2                              | 32,700                             | 1,400              | 0.12                            | 0.2                              |
| 2006-020      |                          | 2                     | 43,600                             | 1,750              | 0.12                            | 0.2                              | 32,700                             | 1,310              | 0.12                            | 0.2                              |
| 2006-030      |                          | 3                     | 43,600                             | 1,090              | 0.1                             | 0.14                             | 32,700                             | 760                | 0.08                            | 0.1                              |
| 2006-040      |                          | 4                     | 32,700                             | 760                | 0.07                            | 0.1                              | 27,300                             | 440                | 0.04                            | 0.06                             |
| 2006-050      |                          | 5                     | 29,500                             | 650                | 0.05                            | 0.08                             | 24,000                             | 330                | 0.02                            | 0.04                             |
| 2006-060      |                          | 6                     | 27,300                             | 550                | 0.04                            | 0.06                             | 21,800                             | 220                | 0.01                            | 0.03                             |
| 2008-020      | R0.4                     | 2                     | 43,600                             | 2,820              | 0.15                            | 0.3                              | 32,700                             | 1,980              | 0.15                            | 0.3                              |
| 2008-030      |                          | 3                     | 43,600                             | 2,180              | 0.15                            | 0.3                              | 32,700                             | 1,530              | 0.15                            | 0.3                              |
| 2008-040      |                          | 4                     | 38,200                             | 1,750              | 0.12                            | 0.2                              | 29,500                             | 1,090              | 0.1                             | 0.16                             |
| 2008-060      |                          | 6                     | 32,700                             | 1,090              | 0.08                            | 0.15                             | 21,800                             | 550                | 0.05                            | 0.1                              |
| 2008-080      |                          | 8                     | 23,800                             | 760                | 0.05                            | 0.06                             | 17,300                             | 320                | 0.02                            | 0.025                            |
| 2010-020      | R0.5                     | 2                     | 39,100                             | 2,740              | 0.25                            | 0.4                              | 30,000                             | 2,050              | 0.25                            | 0.4                              |
| 2010-030      |                          | 3                     | 39,100                             | 2,740              | 0.25                            | 0.4                              | 30,000                             | 1,960              | 0.25                            | 0.4                              |
| 2010-040      |                          | 4                     | 39,100                             | 2,350              | 0.2                             | 0.4                              | 29,500                             | 1,560              | 0.2                             | 0.4                              |
| 2010-050      |                          | 5                     | 38,200                             | 2,180              | 0.16                            | 0.3                              | 29,500                             | 1,530              | 0.12                            | 0.25                             |
| 2010-060      |                          | 6                     | 34,500                             | 1,840              | 0.14                            | 0.3                              | 26,200                             | 1,150              | 0.1                             | 0.25                             |
| 2010-080      |                          | 8                     | 27,300                             | 1,090              | 0.12                            | 0.2                              | 19,600                             | 550                | 0.06                            | 0.1                              |
| 2010-100      |                          | 10                    | 20,300                             | 810                | 0.08                            | 0.15                             | 16,200                             | 300                | 0.03                            | 0.05                             |
| 2010-120      |                          | 12                    | 13,100                             | 490                | 0.06                            | 0.1                              | 9,800                              | 160                | 0.015                           | 0.04                             |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball

Taper Neck Ball

Taper

Barrel

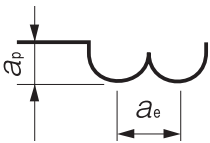
Spiral V Cutter

Drill

Technical Data

## Milling Conditions for DLCLB

| WORK MATERIAL |                          |                       | COPPER / ALUMINUM ALLOYS           |                    |                        |                         | TUNGSTEN COPPER                    |                    |                        |                         |     |
|---------------|--------------------------|-----------------------|------------------------------------|--------------------|------------------------|-------------------------|------------------------------------|--------------------|------------------------|-------------------------|-----|
| Model Number  | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |     |
| 2015-040      | R0.75                    | 4                     | 25,500                             | 2,270              | 0.3                    | 0.6                     | 21,300                             | 1,700              | 0.3                    | 0.6                     |     |
| 2015-060      |                          | 6                     | 25,500                             | 2,040              | 0.3                    | 0.6                     | 21,300                             | 1,530              | 0.3                    | 0.6                     |     |
| 2015-120      |                          | 12                    | 17,500                             | 1,090              | 0.15                   | 0.3                     | 13,100                             | 550                | 0.1                    | 0.2                     |     |
| 2015-180      |                          | 18                    | 8,500                              | 590                | 0.08                   | 0.12                    | 6,800                              | 170                | 0.02                   | 0.06                    |     |
| 2020-040      | R1                       | 4                     | 18,700                             | 2,490              | 0.45                   | 0.8                     | 14,000                             | 1,500              | 0.45                   | 0.8                     |     |
| 2020-060      |                          | 6                     | 18,700                             | 2,080              | 0.45                   | 0.8                     | 14,000                             | 1,250              | 0.45                   | 0.8                     |     |
| 2020-080      |                          | 8                     | 18,700                             | 1,800              | 0.4                    | 0.8                     | 13,500                             | 1,200              | 0.4                    | 0.8                     |     |
| 2020-100      |                          | 10                    | 18,700                             | 1,700              | 0.3                    | 0.6                     | 13,500                             | 1,190              | 0.25                   | 0.5                     |     |
| 2020-120      |                          | 12                    | 16,800                             | 1,470              | 0.3                    | 0.6                     | 12,600                             | 950                | 0.25                   | 0.5                     |     |
| 2020-140      |                          | 14                    | 15,000                             | 1,250              | 0.28                   | 0.5                     | 11,200                             | 750                | 0.18                   | 0.4                     |     |
| 2020-160      |                          | 16                    | 13,100                             | 1,090              | 0.25                   | 0.5                     | 9,800                              | 550                | 0.12                   | 0.25                    |     |
| 2020-200      |                          | 20                    | 10,000                             | 800                | 0.15                   | 0.3                     | 8,000                              | 350                | 0.06                   | 0.1                     |     |
| 2020-250      |                          | 25                    | 6,700                              | 500                | 0.08                   | 0.15                    | 5,000                              | 170                | 0.03                   | 0.05                    |     |
| 2030-100      |                          | R1.5                  | 10                                 | 15,000             | 2,550                  | 0.6                     | 1.2                                | 12,000             | 1,800                  | 0.6                     | 1.2 |
| 2030-120      |                          |                       | 12                                 | 15,000             | 2,550                  | 0.6                     | 1.2                                | 11,800             | 1,740                  | 0.6                     | 1.2 |
| 2030-140      |                          |                       | 14                                 | 15,000             | 2,510                  | 0.6                     | 1.2                                | 11,700             | 1,670                  | 0.6                     | 1.2 |
| 2030-160      | 16                       |                       | 14,200                             | 2,140              | 0.6                    | 1                       | 10,700                             | 1,600              | 0.5                    | 1                       |     |
| 2030-200      | 20                       |                       | 12,700                             | 1,910              | 0.5                    | 0.8                     | 9,500                              | 1,110              | 0.4                    | 0.6                     |     |
| 2030-250      | 25                       |                       | 10,100                             | 1,520              | 0.4                    | 0.6                     | 8,400                              | 760                | 0.2                    | 0.3                     |     |
| 2030-300      | 30                       |                       | 8,700                              | 1,310              | 0.2                    | 0.4                     | 6,500                              | 550                | 0.08                   | 0.15                    |     |
| 2040-100      | R2                       |                       | 10                                 | 11,500             | 2,880                  | 0.8                     | 1.6                                | 8,600              | 2,010                  | 0.8                     | 1.6 |
| 2040-150      |                          | 15                    | 11,500                             | 2,670              | 0.8                    | 1.6                     | 8,600                              | 1,880              | 0.8                    | 1.6                     |     |
| 2040-200      |                          | 20                    | 11,500                             | 2,460              | 0.8                    | 1.6                     | 8,200                              | 1,640              | 0.8                    | 1.2                     |     |
| 2040-250      |                          | 25                    | 10,300                             | 2,210              | 0.6                    | 1.2                     | 6,700                              | 1,270              | 0.5                    | 1                       |     |
| 2040-300      |                          | 30                    | 9,000                              | 1,800              | 0.5                    | 1                       | 5,300                              | 900                | 0.3                    | 0.5                     |     |
| 2040-400      |                          | 40                    | 6,000                              | 900                | 0.4                    | 0.8                     | 3,800                              | 380                | 0.15                   | 0.3                     |     |
| 2060-100      | R3                       | 10                    | 10,000                             | 4,190              | 1                      | 2.2                     | 7,500                              | 3,150              | 1                      | 2.2                     |     |
| 2060-150      |                          | 15                    | 10,000                             | 4,190              | 1                      | 2.2                     | 7,500                              | 2,800              | 1                      | 2.2                     |     |
| 2060-200      |                          | 20                    | 10,000                             | 3,000              | 1                      | 2                       | 7,500                              | 2,000              | 0.7                    | 1.5                     |     |
| 2060-300      |                          | 30                    | 10,000                             | 3,000              | 0.8                    | 1.6                     | 7,000                              | 1,800              | 0.4                    | 0.8                     |     |



## Note:

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when chattering occurs.
- Recommend wet coolant for Copper and Tungsten-Copper.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

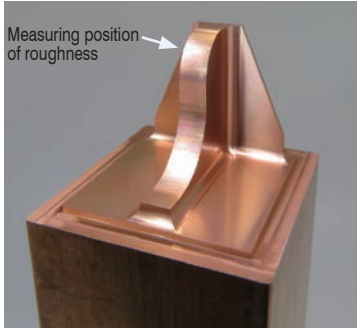
Spiral  
V Cutter

Drill

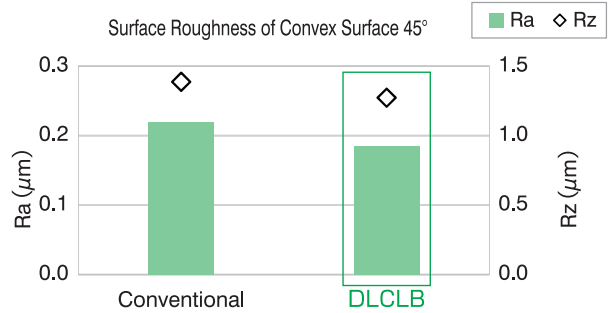
Technical Data

Milling Example of Copper Electrode Model  
DLCLB R1 × EL16

Tough Pitch Copper C1100



Model Size : 20 x 20 x Depth 16 mm  
Coolant : Oil Mist

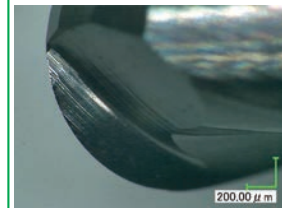
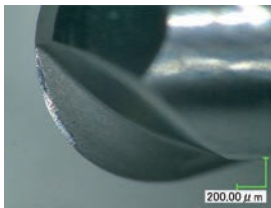


Improved surface roughness compared to the conventional model.

| No | Milling Process | Milling Method  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> (mm)  | a <sub>e</sub> (mm) | Overhang Length (mm) | Cycle Time (h:m:s) |
|----|-----------------|-----------------|------------------------------------|--------------------|----------------------|---------------------|----------------------|--------------------|
| 1  | Roughing        | Contour Milling | 10,800                             | 1,090              | 0.25                 | 0.5                 | 24                   | 1:31:59            |
| 2  | Semi-finishing  |                 | 10,800                             | 1,090              | 0.05                 | 0.05                |                      | 1:31:15            |
| 3  | Finishing       |                 | 13,090                             | 545                | 0.0001 (Cusp Height) | 0.03                |                      | 1:15:26            |
|    |                 |                 |                                    |                    |                      |                     | Total                | 4:18:40            |

Conventional

DLCLB



Tools after milling

DLCLB series Introduction Video



DLCLB series Housing-rib Electrode Milling Video



DLCLB has less wear and damage after 4 hours of milling, and enables stable milling throughout the long cycle time.



## DLCLB Milling example

## Copper Tungsten (Cu30 : W70)



Work Size : 50 x 50 x 50 mm  
Coolant : Oil Mist

| No | Milling Process              | Tool        | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm)           | $a_e$ (mm)           | Allowance (mm) | Cycle Time (h:m:s) |
|----|------------------------------|-------------|------------------------------------|--------------------|----------------------|----------------------|----------------|--------------------|
| 1  | Roughing —                   | R1.5 × EL10 | 12,000                             | 1,800              | 0.6                  | 1.2                  | 0.1            | 0:19:07            |
| 2  | Roughing —                   | R0.75 × EL6 | 21,300                             | 1,530              | 0.3                  | 0.6                  | 0.1            | 0:21:34            |
| 3  | Semi-finishing Flat surface  | R1 × EL6    | 14,000                             | 1,250              | 0.05                 | 0.1                  | 0.05           | 0:32:15            |
| 4  | Semi-finishing Convex Pocket | R0.5 × EL5  | 29,500                             | 1,530              | 0.05                 | 0.06                 | 0.05           | 1:43:09            |
| 5  | Semi-finishing Corner        | R0.4 × EL6  | 21,800                             | 550                | 0.06                 | 0.06                 | 0.05           | 1:10:33            |
| 6  | Finishing Flat surface       | R1 × EL6    | 14,000                             | 1,250              | 0.05                 | 0.04                 | 0              | 1:25:15            |
| 5  | Finishing Convex Pocket      | R0.5 × EL5  | 29,500                             | 1,530              | 0.05                 | 0.028                | 0              | 1:37:19            |
| 6  | Finishing Cylinder corner    | R0.3 × EL5  | 24,000                             | 330                | 0.0002 (Cusp Height) | 0.0002 (Cusp Height) | 0              | 4:54:10            |

Total 12:03:22

DLC coating offers high wear resistance and is suited even for copper tungsten that is hard to mill.

## DLCLB Milling example

## Aluminum A7075



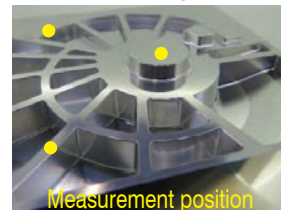
Work Size : 50 x 50 x 50 mm  
Coolant : Water Soluble

Reflection of the background



The surface finish is of such high quality that the letters reflect perfectly in it.

Surface roughness



Average of 3 positions  
 $R_a$  0.03  $\mu$ m

Suited even for Aluminum milling as the cutting edge is sharper than normal endmills for steels.

| No | Milling Process              | Tool        | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm)           | $a_e$ (mm)           | Allowance (mm) | Cycle Time (h:m:s) |
|----|------------------------------|-------------|------------------------------------|--------------------|----------------------|----------------------|----------------|--------------------|
| 1  | Roughing —                   | R1.5 × EL10 | 15,000                             | 2,550              | 0.6                  | 1.2                  | 0.1            | 0:17:49            |
| 2  | Roughing —                   | R0.75 × EL6 | 25,500                             | 2,040              | 0.3                  | 0.6                  | 0.1            | 0:20:22            |
| 3  | Semi-finishing Flat surface  | R1 × EL6    | 18,700                             | 2,100              | 0.05                 | 0.1                  | 0.05           | 0:25:06            |
| 4  | Semi-finishing Convex Pocket | R0.5 × EL5  | 30,000                             | 1,700              | 0.05                 | 0.06                 | 0.05           | 0:53:17            |
| 5  | Semi-finishing Corner        | R0.4 × EL6  | 30,000                             | 1,000              | 0.06                 | 0.06                 | 0.05           | 0:17:02            |
| 6  | Finishing Flat surface       | R1 × EL6    | 18,700                             | 2,100              | 0.05                 | 0.04                 | 0              | 1:06:03            |
| 5  | Finishing Convex Pocket      | R0.5 × EL5  | 30,000                             | 1,700              | 0.05                 | 0.028                | 0              | 1:31:32            |
| 6  | Finishing Cylinder corner    | R0.3 × EL5  | 30,000                             | 650                | 0.0002 (Cusp Height) | 0.0002 (Cusp Height) | 0              | 2:40:18            |

Total 7:31:29

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.2~R3

**CPRB**

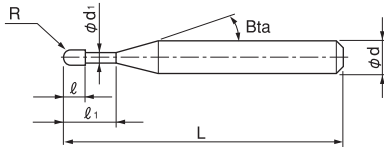


Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        | ○         |                 |          | ●      | ★        |                       |                 |                       |                  |                                       |

**Features**

Long neck ball design for milling Plastics.  
Designed especially for deep rib milling using an undercut form.



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 80 models

Unit (mm)

| Model Number | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|-----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| CPRB 2004-1  | R0.2                  | 1                         | 0.4                  | 0.36                     | 11°                   | 45               | 4                       | 8,000                    |
| CPRB 2004-2  |                       | 2                         |                      |                          |                       | 45               |                         | 8,800                    |
| CPRB 2004-3  |                       | 3                         |                      |                          |                       | 45               |                         | 9,800                    |
| CPRB 2005-2  | R0.25                 | 2                         | 0.8                  | 0.46                     | 11°                   | 45               | 4                       | 8,000                    |
| CPRB 2005-4  |                       | 4                         |                      |                          |                       | 45               |                         | 8,000                    |
| CPRB 2005-6  |                       | 6                         |                      |                          |                       | 45               |                         | 8,800                    |
| CPRB 2005-8  |                       | 8                         |                      |                          |                       | 45               |                         | 8,800                    |
| CPRB 2005-10 |                       | 10                        |                      |                          |                       | 50               |                         | 9,500                    |
| CPRB 2006-2  | R0.3                  | 2                         | 1                    | 0.56                     | 11°                   | 45               | 4                       | 7,200                    |
| CPRB 2006-4  |                       | 4                         |                      |                          |                       | 45               |                         | 7,200                    |
| CPRB 2006-6  |                       | 6                         |                      |                          |                       | 45               |                         | 7,200                    |
| CPRB 2006-8  |                       | 8                         |                      |                          |                       | 45               |                         | 7,200                    |
| CPRB 2008-2  |                       | 2                         |                      |                          |                       | 1.1              |                         | 0.76                     |
| CPRB 2008-4  | 4                     | 45                        | 7,080                |                          |                       |                  |                         |                          |
| CPRB 2008-6  | 6                     | 45                        | 7,080                |                          |                       |                  |                         |                          |
| CPRB 2008-8  | 8                     | 45                        | 7,080                |                          |                       |                  |                         |                          |
| CPRB 2008-10 | 10                    | 50                        | 7,080                |                          |                       |                  |                         |                          |

Unit (mm)

| Model Number | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|-----------------------|---------------------------|----------------------|--------------------------|---------------------------|------------------|-------------------------|--------------------------|
| CPRB 2010-3  | R0.5                  | 3                         | 1.2                  | 0.93                     | 11°                       | 45               | 4                       | 6,120                    |
| CPRB 2010-4  |                       | 4                         |                      |                          |                           | 45               | 4                       | 6,120                    |
| CPRB 2010-6  |                       | 6                         |                      |                          |                           | 45               | 4                       | 6,120                    |
| CPRB 2010-8  |                       | 8                         |                      |                          |                           | 45               | 4                       | 6,120                    |
| CPRB 2010-10 |                       | 10                        |                      |                          |                           | 45               | 4                       | 6,120                    |
| CPRB 2010-12 |                       | 12                        |                      |                          |                           | 45               | 4                       | 6,120                    |
| CPRB 2010-14 |                       | 14                        |                      |                          |                           | 50               | 4                       | 6,120                    |
| CPRB 2010-16 |                       | 16                        |                      |                          |                           | 50               | 4                       | 6,120                    |
| CPRB 2010-20 |                       | 20                        |                      |                          |                           | 55               | 4                       | 7,200                    |
| CPRB 2012-8  |                       | R0.6                      |                      |                          |                           | 8                | 1.3                     | 1.13                     |
| CPRB 2012-12 | 12                    |                           | 45                   | 4                        | 8,000                     |                  |                         |                          |
| CPRB 2014-8  | R0.7                  | 8                         | 1.4                  | 1.33                     | 11°                       | 45               | 4                       | 8,000                    |
| CPRB 2014-12 |                       | 12                        |                      |                          |                           | 45               | 4                       | 8,000                    |
| CPRB 2014-16 |                       | 16                        |                      |                          |                           | 50               | 4                       | 8,000                    |
| CPRB 2015-6  | R0.75                 | 6                         | 1.45                 | 1.43                     | 11°                       | 45               | 4                       | 6,240                    |
| CPRB 2015-8  |                       | 8                         |                      |                          |                           | 45               | 4                       | 6,240                    |
| CPRB 2015-10 |                       | 10                        |                      |                          |                           | 45               | 4                       | 6,240                    |
| CPRB 2015-12 |                       | 12                        |                      |                          |                           | 45               | 4                       | 6,240                    |
| CPRB 2015-16 |                       | 16                        |                      |                          |                           | 50               | 4                       | 6,240                    |
| CPRB 2015-20 |                       | 20                        |                      |                          |                           | 55               | 4                       | 6,240                    |
| CPRB 2016-8  | R0.8                  | 8                         | 1.5                  | 1.5                      | 11°                       | 45               | 4                       | 8,000                    |
| CPRB 2016-12 |                       | 12                        |                      |                          |                           | 45               | 4                       | 8,000                    |
| CPRB 2016-16 |                       | 16                        |                      |                          |                           | 50               | 4                       | 8,000                    |
| CPRB 2016-20 |                       | 20                        |                      |                          |                           | 55               | 4                       | 8,000                    |
| CPRB 2018-8  | R0.9                  | 8                         | 1.6                  | 1.7                      | 11°                       | 45               | 4                       | 8,000                    |
| CPRB 2018-12 |                       | 12                        |                      |                          |                           | 45               | 4                       | 8,000                    |
| CPRB 2018-16 |                       | 16                        |                      |                          |                           | 50               | 4                       | 8,000                    |
| CPRB 2018-20 |                       | 20                        |                      |                          |                           | 55               | 4                       | 8,000                    |
| CPRB 2020-4  | R1                    | 4                         | 1.7                  | 1.9                      | 11°                       | 45               | 4                       | 6,120                    |
| CPRB 2020-6  |                       | 6                         |                      |                          |                           | 45               | 4                       | 6,120                    |
| CPRB 2020-8  |                       | 8                         |                      |                          |                           | 45               | 4                       | 6,120                    |
| CPRB 2020-10 |                       | 10                        |                      |                          |                           | 45               | 4                       | 6,120                    |
| CPRB 2020-12 |                       | 12                        |                      |                          |                           | 45               | 4                       | 6,120                    |
| CPRB 2020-14 |                       | 14                        |                      |                          |                           | 50               | 4                       | 6,120                    |
| CPRB 2020-16 |                       | 16                        |                      |                          |                           | 50               | 4                       | 6,120                    |
| CPRB 2020-20 |                       | 20                        |                      |                          |                           | 55               | 4                       | 6,120                    |
| CPRB 2020-22 |                       | 22                        |                      |                          |                           | 60               | 4                       | 6,120                    |
| CPRB 2020-25 |                       | 25                        |                      |                          |                           | 65               | 4                       | 6,120                    |
| CPRB 2020-30 |                       | 30                        |                      |                          |                           | 70               | 4                       | 7,440                    |

3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius  
Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## 2 Flutes NON-COAT for Plastic Milling

Unit (mm)

| Model Number | Radius of Ball Nose R | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|-----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|
| CPRB 2030-8  | R1.5                  | 8                         | 2.5                  | 2.9                      | 11°                   | 60               | 6                       | 8,640                    |
| CPRB 2030-10 |                       | 10                        |                      |                          |                       | 60               | 6                       | 8,640                    |
| CPRB 2030-12 |                       | 12                        |                      |                          |                       | 60               | 6                       | 8,640                    |
| CPRB 2030-16 |                       | 16                        |                      |                          |                       | 60               | 6                       | 8,640                    |
| CPRB 2030-20 |                       | 20                        |                      |                          |                       | 70               | 6                       | 8,640                    |
| CPRB 2030-25 |                       | 25                        |                      |                          |                       | 70               | 6                       | 8,640                    |
| CPRB 2030-30 |                       | 30                        |                      |                          |                       | 70               | 6                       | 8,640                    |
| CPRB 2030-35 |                       | 35                        |                      |                          |                       | 80               | 6                       | 10,080                   |
| CPRB 2040-10 | R2                    | 10                        | 3                    | 3.8                      | 11°                   | 70               | 6                       | 8,640                    |
| CPRB 2040-12 |                       | 12                        |                      |                          |                       | 70               | 6                       | 8,640                    |
| CPRB 2040-16 |                       | 16                        |                      |                          |                       | 70               | 6                       | 8,640                    |
| CPRB 2040-20 |                       | 20                        |                      |                          |                       | 70               | 6                       | 8,640                    |
| CPRB 2040-25 |                       | 25                        |                      |                          |                       | 70               | 6                       | 8,640                    |
| CPRB 2040-30 |                       | 30                        |                      |                          |                       | 70               | 6                       | 8,640                    |
| CPRB 2040-35 |                       | 35                        |                      |                          |                       | 80               | 6                       | 8,880                    |
| CPRB 2040-40 |                       | 40                        |                      |                          |                       | 90               | 6                       | 9,120                    |
| CPRB 2040-45 |                       | 45                        |                      |                          |                       | 90               | 6                       | 10,320                   |
| CPRB 2040-50 |                       | 50                        |                      |                          |                       | 100              | 6                       | 11,280                   |
| CPRB 2050-20 | R2.5                  | 20                        | 3.5                  | 4.8                      | 11°                   | 70               | 6                       | 12,080                   |
| CPRB 2050-25 |                       | 25                        |                      |                          |                       | 70               | 6                       | 12,080                   |
| CPRB 2050-30 |                       | 30                        |                      |                          |                       | 80               | 6                       | 13,130                   |
| CPRB 2050-35 |                       | 35                        |                      |                          |                       | 80               | 6                       | 13,130                   |
| CPRB 2060-30 | R3                    | 30                        | 6                    | 5.8                      | —                     | 80               | 6                       | 10,080                   |
| CPRB 2060-50 |                       | 50                        |                      |                          | —                     | 120              | 6                       | 12,180                   |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

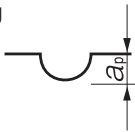
Drill

Technical Data

## Milling Conditions for CPRB

| WORK MATERIAL |                          | ALUMINUM ALLOYS                    |                    |                        | PLASTICS                           |                    |                        |
|---------------|--------------------------|------------------------------------|--------------------|------------------------|------------------------------------|--------------------|------------------------|
| Model Number  | Radius of Ball Nose (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Axial Depth $a_p$ (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Axial Depth $a_p$ (mm) |
| 2004          | R0.2                     | 35,000                             | 560                | 0.005~0.01             | 35,000                             | 1,100              | 0.07~0.2               |
| 2005          | R0.25                    | 35,000                             | 700                | 0.003~0.01             | 28,000                             | 1,200              | 0.08~0.25              |
| 2006          | R0.3                     | 35,000                             | 910                | 0.006~0.03             | 24,000                             | 1,200              | 0.1 ~0.3               |
| 2008          | R0.4                     | 26,000                             | 940                | 0.006~0.05             | 18,000                             | 900                | 0.13~0.4               |
| 2010          | R0.5                     | 21,000                             | 970                | 0.005~0.08             | 14,000                             | 700                | 0.17~0.5               |
| 2012          | R0.6                     | 18,000                             | 1,010              | 0.04 ~0.09             | 12,000                             | 600                | 0.2 ~0.6               |
| 2014          | R0.7                     | 15,000                             | 1,020              | 0.05 ~0.1              | 10,000                             | 500                | 0.23~0.7               |
| 2015          | R0.75                    | 14,000                             | 1,010              | 0.06 ~0.12             | 9,500                              | 480                | 0.25~0.75              |
| 2016          | R0.8                     | 13,000                             | 1,010              | 0.08 ~0.13             | 9,000                              | 450                | 0.27~0.8               |
| 2018          | R0.9                     | 12,000                             | 1,060              | 0.09 ~0.15             | 8,000                              | 400                | 0.3 ~0.9               |
| 2020          | R1                       | 11,000                             | 1,100              | 0.03 ~0.21             | 7,000                              | 350                | 0.33~1                 |
| 2030          | R1.5                     | 6,900                              | 760                | 0.03 ~0.23             | 4,800                              | 240                | 0.5 ~1.5               |
| 2040          | R2                       | 5,200                              | 690                | 0.01 ~0.28             | 3,600                              | 180                | 0.6 ~2                 |
| 2050          | R2.5                     | 4,200                              | 590                | 0.16 ~0.31             | 2,900                              | 150                | 0.8 ~2.5               |
| 2060          | R3                       | 3,500                              | 550                | 0.22 ~0.36             | 2,400                              | 120                | 1 ~3                   |

Slotting



Note:

- Adjust the axial depth ( $a_p$ ) based on the effective length and milling condition.
- Recommend water soluble coolant for Aluminum Alloys and Copper.
- Recommend air blow for Plastics.
- Remove chips from the work piece to keep the milling surface quality.
- If chips clog on the tool, stop the operation and remove them accordingly.

|                        |                        |
|------------------------|------------------------|
| Ball / Long Shank Ball | Ball / Long Shank Ball |
| Long Neck Ball         | Long Neck Ball         |
| Taper Neck Ball        | Taper Neck Ball        |
| Taper                  | Taper                  |
| Barrel                 | Barrel                 |
| Spiral V Cutter        | Spiral V Cutter        |
| Drill                  | Drill                  |
| Technical Data         | Technical Data         |



Size R0.3~R3

**CFLB**



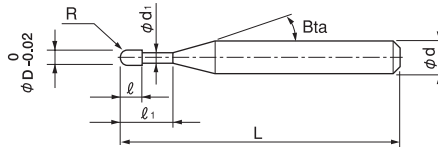
R0.3~R1.5

R2~R3

R2~R3

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        | ○         | ●               |          | ○      |          | ●                     | ●               |                       |                  |                                       |



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

**Features**

Suited for various heat-resistant alloys including Titanium and Inconel due to large pocket, variable pitch and high lubricity coating.  
Tip slot design offers clean milling surfaces even for Copper, Aluminum and Acrylic.



Copper C1100



Acrylic



Aluminum A7075

**3 series of tip slot ball**

Raw materials 40 50 55 60 65 Hardness (HRC)



**CFB** 3 flute ball, Flute design: Positive  
**CFLB** 3 flute long neck ball

**HFB** 4 flute ball, Flute design: Negative



3 flute ball CFB series (P442) and 4 flute ball HFB series for hard materials (P452) are also available.



Total 47 models

Unit (mm)

| Model Number  | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter $\phi d$ | Shank Taper Angle $\beta$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Effective Length by Inclined Angles |                 |                 |                 |                 |
|---------------|-----------------------|------------------------|-------------------|------------------------|---------------------------|------------------|-------------------------|--------------------------|-------------------------------------|-----------------|-----------------|-----------------|-----------------|
|               |                       |                        |                   |                        |                           |                  |                         |                          | 30°                                 | 1°              | 1°30'           | 2°              | 3°              |
| CFLB 3006-020 | R0.3                  | 2                      | 0.48              | 0.58                   | 16°                       | 50               | 4                       | 6,970                    | 2.16                                | 2.23            | 2.30            | 2.37            | 2.53            |
| CFLB 3006-030 |                       | 3                      |                   |                        |                           | 50               | 4                       | 7,130                    | 3.20                                | 3.30            | 3.40            | 3.51            | 3.76            |
| CFLB 3006-040 |                       | 4                      |                   |                        |                           | 50               | 4                       | 7,380                    | 4.23                                | 4.36            | 4.50            | 4.65            | 4.98            |
| CFLB 3006-060 |                       | 6                      |                   |                        |                           | 50               | 4                       | 7,380                    | 6.30                                | 6.49            | 6.70            | 6.93            | 7.43            |
| CFLB 3008-040 | R0.4                  | 4                      | 0.64              | 0.78                   | 16°                       | 50               | 4                       | 7,380                    | 4.23                                | 4.36            | 4.49            | 4.64            | 4.96            |
| CFLB 3008-060 |                       | 6                      |                   |                        |                           | 50               | 4                       | 7,380                    | 6.29                                | 6.49            | 6.69            | 6.91            | 7.41            |
| CFLB 3008-080 |                       | 8                      |                   |                        |                           | 50               | 4                       | 7,380                    | 8.36                                | 8.62            | 8.89            | 9.19            | 9.85            |
| CFLB 3010-025 | R0.5                  | 2.5                    | 0.8               | 0.96                   | 16°                       | 50               | 4                       | 6,310                    | 2.71                                | 2.79            | 2.87            | 2.95            | 3.14            |
| CFLB 3010-030 |                       | 3                      |                   |                        |                           | 50               | 4                       | 6,310                    | 3.23                                | 3.32            | 3.42            | 3.52            | 3.75            |
| CFLB 3010-040 |                       | 4                      |                   |                        |                           | 50               | 4                       | 6,560                    | 4.26                                | 4.38            | 4.52            | 4.66            | 4.98            |
| CFLB 3010-050 |                       | 5                      |                   |                        |                           | 50               | 4                       | 6,560                    | 5.29                                | 5.45            | 5.62            | 5.80            | 6.20            |
| CFLB 3010-060 |                       | 6                      |                   |                        |                           | 50               | 4                       | 6,970                    | 6.32                                | 6.51            | 6.72            | 6.94            | 7.42            |
| CFLB 3010-080 |                       | 8                      |                   |                        |                           | 50               | 4                       | 6,970                    | 8.39                                | 8.64            | 8.92            | 9.21            | 9.87            |
| CFLB 3010-100 |                       | 10                     |                   |                        |                           | 50               | 4                       | 6,970                    | 10.45                               | 10.77           | 11.12           | 11.49           | 12.32           |
| CFLB 3010-120 |                       | 12                     |                   |                        |                           | 50               | 4                       | 6,970                    | 12.51                               | 12.90           | 13.32           | 13.77           | 14.76           |
| CFLB 3015-040 | R0.75                 | 4                      | 1.2               | 1.43                   | 16°                       | 50               | 4                       | 6,970                    | 4.18                                | 4.29            | 4.41            | 4.54            | 4.83            |
| CFLB 3015-060 |                       | 6                      |                   |                        |                           | 50               | 4                       | 6,970                    | 6.24                                | 6.42            | 6.61            | 6.82            | 7.28            |
| CFLB 3015-080 |                       | 8                      |                   |                        |                           | 50               | 4                       | 7,220                    | 8.30                                | 8.55            | 8.82            | 9.10            | 9.73            |
| CFLB 3015-100 |                       | 10                     |                   |                        |                           | 50               | 4                       | 7,380                    | 10.37                               | 10.68           | 11.02           | 11.38           | 12.18           |
| CFLB 3015-120 |                       | 12                     |                   |                        |                           | 50               | 4                       | 7,950                    | 12.43                               | 12.81           | 13.22           | 13.65           | 14.62           |
| CFLB 3015-160 |                       | 16                     |                   |                        |                           | 50               | 4                       | 7,950                    | 16.56                               | 17.07           | 17.62           | 18.21           | 19.52           |
| CFLB 3020-040 | R1                    | 4                      | 1.6               | 1.83                   | 16°                       | 50               | 4                       | 6,300                    | 4.35                                | 4.46            | 4.58            | 4.71            | 4.99            |
| CFLB 3020-060 |                       | 6                      |                   |                        |                           | 50               | 4                       | 6,810                    | 6.41                                | 6.59            | 6.78            | 6.99            | 7.44            |
| CFLB 3020-080 |                       | 8                      |                   |                        |                           | 50               | 4                       | 6,970                    | 8.48                                | 8.72            | 8.98            | 9.26            | 9.89            |
| CFLB 3020-100 |                       | 10                     |                   |                        |                           | 50               | 4                       | 6,970                    | 10.54                               | 10.85           | 11.18           | 11.54           | 12.33           |
| CFLB 3020-120 |                       | 12                     |                   |                        |                           | 50               | 4                       | 7,220                    | 12.60                               | 12.98           | 13.38           | 13.82           | 14.78           |
| CFLB 3020-140 |                       | 14                     |                   |                        |                           | 50               | 4                       | 7,220                    | 14.66                               | 15.11           | 15.59           | 16.09           | 17.23           |
| CFLB 3020-160 |                       | 16                     |                   |                        |                           | 50               | 4                       | 7,220                    | 16.73                               | 17.24           | 17.79           | 18.37           | 19.68           |
| CFLB 3020-180 |                       | 18                     |                   |                        |                           | 55               | 4                       | 7,220                    | 18.79                               | 19.37           | 19.99           | 20.65           | No Interference |
| CFLB 3020-200 |                       | 20                     |                   |                        |                           | 55               | 4                       | 7,220                    | 20.85                               | 21.50           | 22.19           | 22.93           | No Interference |
| CFLB 3030-080 |                       | R1.5                   |                   |                        |                           | 8                | 2.4                     | 2.73                     | 16°                                 | 60              | 6               | 6,970           | 8.64            |
| CFLB 3030-100 | 10                    |                        | 60                | 6                      | 7,630                     | 10.70            |                         |                          |                                     | 11.00           | 11.33           | 11.67           | 12.44           |
| CFLB 3030-120 | 12                    |                        | 60                | 6                      | 7,630                     | 12.77            |                         |                          |                                     | 13.14           | 13.53           | 13.96           | 14.89           |
| CFLB 3030-160 | 16                    |                        | 60                | 6                      | 7,950                     | 16.89            |                         |                          |                                     | 17.39           | 17.93           | 18.50           | 19.78           |
| CFLB 3030-200 | 20                    |                        | 70                | 6                      | 8,040                     | 21.02            |                         |                          |                                     | 21.65           | 22.33           | 23.06           | 24.68           |
| CFLB 3030-250 | 25                    |                        | 70                | 6                      | 8,040                     | 26.17            |                         |                          |                                     | 26.98           | 27.83           | 28.75           | No Interference |
| CFLB 3040-100 | R2                    | 10                     | 3.2               | 3.63                   | 16°                       | 70               | 6                       | 7,200                    | 10.87                               | 11.16           | 11.47           | 11.80           | 12.54           |
| CFLB 3040-120 |                       | 12                     |                   |                        |                           | 70               | 6                       | 7,380                    | 12.93                               | 13.29           | 13.67           | 14.08           | 14.99           |
| CFLB 3040-160 |                       | 16                     |                   |                        |                           | 70               | 6                       | 7,710                    | 17.06                               | 17.55           | 18.07           | 18.63           | 19.89           |
| CFLB 3040-200 |                       | 20                     |                   |                        |                           | 70               | 6                       | 8,200                    | 21.18                               | 21.81           | 22.47           | 23.19           | No Interference |
| CFLB 3040-250 |                       | 25                     |                   |                        |                           | 70               | 6                       | 8,200                    | 26.34                               | 27.13           | 27.98           | 28.88           | No Interference |
| CFLB 3040-300 |                       | 30                     |                   |                        |                           | 70               | 6                       | 8,200                    | 31.50                               | 32.45           | 33.48           | No Interference | No Interference |
| CFLB 3060-200 | R3                    | 20                     | 4.8               | 5.42                   | —                         | 80               | 6                       | 9,840                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CFLB 3060-250 |                       | 25                     |                   |                        |                           | 80               | 6                       | 9,840                    | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CFLB 3060-300 |                       | 30                     |                   |                        |                           | 80               | 6                       | 10,090                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CFLB 3060-350 |                       | 35                     |                   |                        |                           | 80               | 6                       | 10,500                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |
| CFLB 3060-400 |                       | 40                     |                   |                        |                           | 90               | 6                       | 11,070                   | No Interference                     | No Interference | No Interference | No Interference | No Interference |

- 3 Flutes
- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Milling Conditions for CFLB

| WORK MATERIAL  |                       |                       | COPPER ALUMINUM ALLOYS<br>C1100 / A5052 / A7075 etc. |                    |                                 |                                  | CARBON STEELS / ALLOY STEELS / HARDENED STEELS<br>S50C / NAK80 etc.<br>(~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>STAVAX / SKD61 etc.<br>(~55HRC) |                    |                                 |                                  |      |
|--|-----------------------|-----------------------|--|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|------|
| Coolant  |                       |                       | WET  |                    |                                 |                                  | WET / DRY   |                    |                                 |                                  | WET / DRY  |                    |                                 |                                  |      |
| Model Number   | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                 | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |      |
| φ3mm Shank<br>V Series<br><br>UDC-PCD<br>Series<br><br>CBN<br>Series<br><br>Square<br><br>Long Neck<br>Square<br><br>Radius<br><br>Long Neck<br>Radius<br><br>Taper Neck<br>Radius<br><br>Ball / Long<br>Shank Ball<br><br>Long Neck<br>Ball<br><br>Taper Neck<br>Ball<br><br>Taper<br><br>Barrel<br><br>Spiral<br>V Cutter<br><br>Drill<br><br>Technical Data | R0.3                  | 3006-020              | 2  | 30,000             | 1,000                           | 0.03                             | 0.13  | 30,000             | 1,000                           | 0.03                             | 0.13   | 30,000             | 700                             | 0.03                             | 0.13 |
|  |                       | 3006-030              | 3  | 30,000             | 1,000                           | 0.03                             | 0.13  | 30,000             | 1,000                           | 0.03                             | 0.13   | 30,000             | 700                             | 0.03                             | 0.13 |
|  |                       | 3006-040              | 4  | 30,000             | 700                             | 0.02                             | 0.1   | 30,000             | 700                             | 0.02                             | 0.1  | 30,000             | 480                             | 0.02                             | 0.1  |
|  |                       | 3006-060              | 6  | 30,000             | 475                             | 0.01                             | 0.05  | 30,000             | 475                             | 0.01                             | 0.05   | 30,000             | 300                             | 0.01                             | 0.05 |
| R0.4   | 3008-040              | 4                     | 30,000   | 1,250              | 0.04                            | 0.17                             | 30,000  | 1,250              | 0.04                            | 0.17                             | 30,000   | 850                | 0.04                            | 0.17                             |      |
|  | 3008-060              | 6                     | 30,000   | 1,000              | 0.03                            | 0.14                             | 30,000  | 1,000              | 0.03                            | 0.14                             | 30,000   | 680                | 0.03                            | 0.14                             |      |
|  | 3008-080              | 8                     | 27,000   | 770                | 0.018                           | 0.12                             | 27,000  | 770                | 0.018                           | 0.12                             | 27,000   | 510                | 0.018                           | 0.12                             |      |
|  | 3010-025              | 2.5                   | 30,000   | 1,500              | 0.05                            | 0.21                             | 30,000  | 1,500              | 0.05                            | 0.21                             | 30,000   | 1,000              | 0.05                            | 0.21                             |      |
| R0.5   | 3010-030              | 3                     | 30,000   | 1,500              | 0.05                            | 0.21                             | 30,000  | 1,500              | 0.05                            | 0.21                             | 30,000   | 1,000              | 0.05                            | 0.21                             |      |
|  | 3010-040              | 4                     | 30,000   | 1,500              | 0.05                            | 0.21                             | 30,000  | 1,500              | 0.05                            | 0.21                             | 30,000   | 1,000              | 0.05                            | 0.21                             |      |
|  | 3010-050              | 5                     | 30,000   | 1,500              | 0.05                            | 0.21                             | 30,000  | 1,500              | 0.05                            | 0.21                             | 30,000   | 1,000              | 0.05                            | 0.21                             |      |
|  | 3010-060              | 6                     | 30,000   | 1,500              | 0.04                            | 0.19                             | 30,000  | 1,500              | 0.04                            | 0.19                             | 30,000   | 1,000              | 0.04                            | 0.19                             |      |
|  | 3010-080              | 8                     | 25,200   | 1,200              | 0.03                            | 0.17                             | 25,200  | 1,200              | 0.03                            | 0.17                             | 25,200   | 800                | 0.03                            | 0.17                             |      |
|  | 3010-100              | 10                    | 24,100   | 930                | 0.023                           | 0.15                             | 24,100  | 930                | 0.023                           | 0.15                             | 24,100   | 620                | 0.023                           | 0.155                            |      |
| R0.75  | 3010-120              | 12                    | 23,000   | 660                | 0.017                           | 0.135                            | 23,000  | 660                | 0.017                           | 0.135                            | 23,000   | 440                | 0.017                           | 0.135                            |      |
|  | 3015-040              | 4                     | 30,000   | 2,500              | 0.075                           | 0.32                             | 30,000  | 2,500              | 0.075                           | 0.32                             | 30,000   | 1,700              | 0.075                           | 0.32                             |      |
|  | 3015-060              | 6                     | 30,000   | 2,500              | 0.075                           | 0.32                             | 30,000  | 2,500              | 0.075                           | 0.32                             | 30,000   | 1,700              | 0.075                           | 0.32                             |      |
|  | 3015-080              | 8                     | 30,000   | 2,500              | 0.075                           | 0.32                             | 30,000  | 2,500              | 0.075                           | 0.32                             | 30,000   | 1,700              | 0.075                           | 0.32                             |      |
|  | 3015-100              | 10                    | 24,000   | 2,000              | 0.05                            | 0.26                             | 24,000  | 2,000              | 0.05                            | 0.26                             | 24,000   | 1,350              | 0.05                            | 0.26                             |      |
|  | 3015-120              | 12                    | 20,800   | 1,400              | 0.035                           | 0.25                             | 20,800  | 1,400              | 0.035                           | 0.25                             | 20,800   | 925                | 0.035                           | 0.23                             |      |
| R1   | 3015-160              | 16                    | 17,500   | 800                | 0.025                           | 0.24                             | 17,500  | 800                | 0.025                           | 0.24                             | 17,500   | 500                | 0.017                           | 0.2                              |      |
|  | 3020-040              | 4                     | 30,000   | 3,200              | 0.2                             | 0.6                              | 30,000  | 3,200              | 0.2                             | 0.6                              | 30,000   | 2,500              | 0.2                             | 0.6                              |      |
|  | 3020-060              | 6                     | 30,000   | 3,200              | 0.2                             | 0.6                              | 30,000  | 3,200              | 0.2                             | 0.6                              | 30,000   | 2,500              | 0.2                             | 0.6                              |      |
|  | 3020-080              | 8                     | 30,000   | 3,200              | 0.2                             | 0.6                              | 30,000  | 3,200              | 0.2                             | 0.6                              | 29,150   | 2,400              | 0.2                             | 0.6                              |      |
|  | 3020-100              | 10                    | 27,000   | 3,000              | 0.2                             | 0.6                              | 27,000  | 3,000              | 0.2                             | 0.6                              | 24,300   | 2,000              | 0.2                             | 0.6                              |      |
|  | 3020-120              | 12                    | 21,600   | 2,400              | 0.15                            | 0.5                              | 21,600  | 2,400              | 0.15                            | 0.5                              | 21,000   | 1,600              | 0.14                            | 0.5                              |      |
|  | 3020-140              | 14                    | 16,200   | 1,600              | 0.12                            | 0.45                             | 16,200  | 1,600              | 0.12                            | 0.45                             | 16,200   | 1,200              | 0.08                            | 0.35                             |      |
|  | 3020-160              | 16                    | 12,600   | 1,200              | 0.1                             | 0.4                              | 12,600  | 1,200              | 0.1                             | 0.4                              | 12,600   | 1,200              | 0.05                            | 0.3                              |      |
|  | 3020-180              | 18                    | 12,350   | 1,060              | 0.07                            | 0.375                            | 12,350  | 1,060              | 0.07                            | 0.375                            | 12,350   | 900                | 0.035                           | 0.285                            |      |
|  | 3020-200              | 20                    | 12,050   | 930                | 0.04                            | 0.35                             | 12,050  | 930                | 0.04                            | 0.35                             | 12,050   | 600                | 0.017                           | 0.27                             |      |
| R1.5   | 3030-080              | 8                     | 24,000   | 4,000              | 0.3                             | 0.9                              | 24,000  | 4,000              | 0.3                             | 0.9                              | 21,600   | 2,700              | 0.3                             | 0.9                              |      |
|  | 3030-100              | 10                    | 24,000   | 4,000              | 0.3                             | 0.9                              | 24,000  | 4,000              | 0.3                             | 0.9                              | 21,600   | 2,700              | 0.3                             | 0.9                              |      |
|  | 3030-120              | 12                    | 24,000   | 3,600              | 0.3                             | 0.9                              | 24,000  | 3,600              | 0.3                             | 0.9                              | 21,600   | 2,450              | 0.3                             | 0.9                              |      |
|  | 3030-160              | 16                    | 16,800   | 2,800              | 0.27                            | 0.85                             | 16,800  | 2,800              | 0.27                            | 0.85                             | 15,100   | 1,900              | 0.27                            | 0.85                             |      |
|  | 3030-200              | 20                    | 12,000   | 2,000              | 0.24                            | 0.75                             | 12,000  | 2,000              | 0.24                            | 0.75                             | 10,800   | 1,350              | 0.24                            | 0.75                             |      |
|  | 3030-250              | 25                    | 8,400  | 1,200              | 0.15                            | 0.65                             | 8,400   | 1,200              | 0.15                            | 0.65                             | 7,500  | 800                | 0.15                            | 0.65                             |      |



# Milling Conditions for CFLB

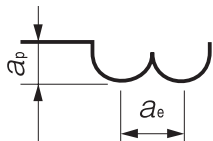
3 Flutes

| WORK MATERIAL |                       |                       | TITANIUM ALLOYS<br>STAINLESS STEELS<br>Ti-6Al-4V / SUS etc. |                    |                                 |                                  | HEAT RESISTANT ALLOYS<br>Inconel718 |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|-------------------------------------|--------------------|---------------------------------|----------------------------------|
| Coolant       |                       |                       | WET   |                    |                                 |                                  | WET                                 |                    |                                 |                                  |
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 3006-020      | R0.3                  | 2                     | 20,000  | 1,000              | 0.015                           | 0.09                             | 9,000                               | 225                | 0.015                           | 0.09                             |
| 3006-030      |                       | 3                     | 20,000  | 1,000              | 0.015                           | 0.09                             | 7,500                               | 185                | 0.012                           | 0.08                             |
| 3006-040      |                       | 4                     | 20,000  | 700                | 0.01                            | 0.07                             | 4,500                               | 100                | 0.01                            | 0.07                             |
| 3006-060      |                       | 6                     | 20,000  | 200                | 0.005                           | 0.035                            | 2,400                               | 30                 | 0.004                           | 0.035                            |
| 3008-040      | R0.4                  | 4                     | 20,000  | 1,250              | 0.02                            | 0.12                             | 10,000                              | 310                | 0.02                            | 0.12                             |
| 3008-060      |                       | 6                     | 20,000  | 950                | 0.013                           | 0.075                            | 7,200                               | 200                | 0.013                           | 0.075                            |
| 3008-080      |                       | 8                     | 18,000  | 600                | 0.007                           | 0.06                             | 4,450                               | 95                 | 0.007                           | 0.06                             |
| 3010-025      | R0.5                  | 2.5                   | 20,000  | 1,500              | 0.025                           | 0.15                             | 10,000                              | 375                | 0.025                           | 0.15                             |
| 3010-030      |                       | 3                     | 20,000  | 1,500              | 0.025                           | 0.15                             | 10,000                              | 375                | 0.025                           | 0.15                             |
| 3010-040      |                       | 4                     | 20,000  | 1,500              | 0.025                           | 0.15                             | 9,000                               | 330                | 0.025                           | 0.15                             |
| 3010-050      |                       | 5                     | 20,000  | 1,500              | 0.025                           | 0.15                             | 7,500                               | 280                | 0.02                            | 0.14                             |
| 3010-060      |                       | 6                     | 20,000  | 1,500              | 0.02                            | 0.14                             | 6,000                               | 220                | 0.02                            | 0.13                             |
| 3010-080      |                       | 8                     | 16,800  | 1,200              | 0.015                           | 0.12                             | 3,500                               | 110                | 0.015                           | 0.11                             |
| 3010-100      |                       | 10                    | 16,050  | 930                | 0.011                           | 0.1                              | 3,350                               | 85                 | 0.011                           | 0.095                            |
| 3010-120      | 12                    | 15,300                | 660   | 0.008              | 0.095                           | 3,200                            | 60                                  | 0.008              | 0.085                           |                                  |
| 3015-040      | R0.75                 | 4                     | 20,000  | 2,500              | 0.035                           | 0.22                             | 9,000                               | 380                | 0.03                            | 0.22                             |
| 3015-060      |                       | 6                     | 20,000  | 2,500              | 0.035                           | 0.22                             | 9,000                               | 380                | 0.03                            | 0.22                             |
| 3015-080      |                       | 8                     | 20,000  | 2,500              | 0.035                           | 0.22                             | 6,000                               | 250                | 0.025                           | 0.18                             |
| 3015-100      |                       | 10                    | 16,000  | 2,000              | 0.025                           | 0.19                             | 4,500                               | 170                | 0.02                            | 0.17                             |
| 3015-120      |                       | 12                    | 14,000  | 1,370              | 0.02                            | 0.18                             | 4,100                               | 135                | 0.017                           | 0.17                             |
| 3015-160      |                       | 16                    | 12,000  | 730                | 0.013                           | 0.17                             | 3,600                               | 100                | 0.013                           | 0.165                            |
| 3020-040      | R1                    | 4                     | 20,000  | 3,200              | 0.1                             | 0.43                             | 12,000                              | 1,000              | 0.1                             | 0.4                              |
| 3020-060      |                       | 6                     | 20,000  | 3,200              | 0.1                             | 0.43                             | 12,000                              | 1,000              | 0.1                             | 0.4                              |
| 3020-080      |                       | 8                     | 20,000  | 3,200              | 0.1                             | 0.43                             | 10,800                              | 900                | 0.1                             | 0.4                              |
| 3020-100      |                       | 10                    | 18,000  | 3,000              | 0.1                             | 0.43                             | 9,000                               | 750                | 0.08                            | 0.36                             |
| 3020-120      |                       | 12                    | 14,400  | 2,400              | 0.075                           | 0.38                             | 7,200                               | 600                | 0.08                            | 0.34                             |
| 3020-140      |                       | 14                    | 10,800  | 1,600              | 0.06                            | 0.34                             | 5,400                               | 400                | 0.07                            | 0.32                             |
| 3020-160      |                       | 16                    | 8,400   | 1,200              | 0.05                            | 0.34                             | 4,200                               | 300                | 0.06                            | 0.3                              |
| 3020-180      |                       | 18                    | 8,250   | 1,000              | 0.035                           | 0.26                             | 4,100                               | 250                | 0.035                           | 0.26                             |
| 3020-200      |                       | 20                    | 8,050   | 800                | 0.017                           | 0.245                            | 4,000                               | 200                | 0.015                           | 0.23                             |
| 3030-080      | R1.5                  | 8                     | 16,000  | 4,000              | 0.15                            | 0.65                             | 8,000                               | 1,000              | 0.15                            | 0.65                             |
| 3030-100      |                       | 10                    | 16,000  | 4,000              | 0.15                            | 0.65                             | 7,200                               | 900                | 0.15                            | 0.65                             |
| 3030-120      |                       | 12                    | 16,000  | 3,600              | 0.15                            | 0.65                             | 7,200                               | 800                | 0.15                            | 0.65                             |
| 3030-160      |                       | 16                    | 11,200  | 2,800              | 0.135                           | 0.62                             | 4,800                               | 600                | 0.12                            | 0.55                             |
| 3030-200      |                       | 20                    | 8,000   | 2,000              | 0.12                            | 0.58                             | 3,600                               | 400                | 0.1                             | 0.52                             |
| 3030-250      |                       | 25                    | 5,600   | 1,200              | 0.075                           | 0.46                             | 2,800                               | 300                | 0.09                            | 0.48                             |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Milling Conditions for CFLB

| WORK MATERIAL |                       |                       | COPPER<br>ALUMINUM ALLOYS<br>C1100 / A5052 / A7075 etc. |                    |                                 |                                  | CARBON STEELS / ALLOY<br>STEELS / HARDENED STEELS<br>S50C / NAK80 etc<br>(~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>STAVAX / SKD61 etc.<br>(~55HRC) |                    |                                 |                                  |
|---------------|-----------------------|-----------------------|---|--------------------|---------------------------------|----------------------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Coolant       |                       |                       | WET   |                    |                                 |                                  | WET / DRY   |                    |                                 |                                  | WET / DRY  |                    |                                 |                                  |
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                      | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )                 | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 3040-100      | R2                    | 10                    | 18,000  | 4,000              | 0.4                             | 1.2                              | 18,000  | 4,000              | 0.4                             | 1.2                              | 16,200   | 2,700              | 0.4                             | 1.2                              |
|               |                       | 12                    | 18,000  | 4,000              | 0.4                             | 1.2                              | 18,000  | 4,000              | 0.4                             | 1.2                              | 16,200   | 2,700              | 0.4                             | 1.2                              |
|               |                       | 16                    | 16,200  | 3,600              | 0.4                             | 1.2                              | 16,200  | 3,600              | 0.4                             | 1.2                              | 14,600   | 2,450              | 0.4                             | 1.2                              |
|               |                       | 20                    | 13,500  | 3,000              | 0.4                             | 1.2                              | 13,500  | 3,000              | 0.4                             | 1.2                              | 12,200   | 2,000              | 0.4                             | 1.2                              |
|               |                       | 25                    | 9,900   | 2,200              | 0.32                            | 1.05                             | 9,900   | 2,200              | 0.32                            | 1.05                             | 8,900  | 1,450              | 0.32                            | 1.05                             |
|               |                       | 30                    | 7,200   | 1,400              | 0.2                             | 0.85                             | 7,200   | 1,400              | 0.2                             | 0.85                             | 6,500  | 950                | 0.2                             | 0.85                             |
| 3060-200      | R3                    | 20                    | 12,000  | 4,000              | 0.6                             | 1.8                              | 12,000  | 4,000              | 0.6                             | 1.8                              | 10,800   | 2,700              | 0.6                             | 1.8                              |
|               |                       | 25                    | 10,500  | 3,500              | 0.6                             | 1.8                              | 10,500  | 3,500              | 0.6                             | 1.8                              | 9,450  | 2,350              | 0.6                             | 1.8                              |
|               |                       | 30                    | 9,000   | 3,000              | 0.6                             | 1.8                              | 9,000   | 3,000              | 0.6                             | 1.8                              | 8,100  | 2,000              | 0.6                             | 1.8                              |
|               |                       | 35                    | 7,500   | 2,500              | 0.6                             | 1.8                              | 7,500   | 2,500              | 0.5                             | 1.6                              | 6,750  | 1,650              | 0.5                             | 1.6                              |
|               |                       | 40                    | 6,000   | 2,000              | 0.4                             | 1.4                              | 6,000   | 2,000              | 0.4                             | 1.4                              | 5,400  | 1,350              | 0.4                             | 1.4                              |



Note:

- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machines maximum speed, or when the tool is chattering and heats up to a red color.
- Recommend wet coolant for Copper.
- DRY: air blow, WET: water soluble or oil coolant.

## Milling Conditions for CFLB

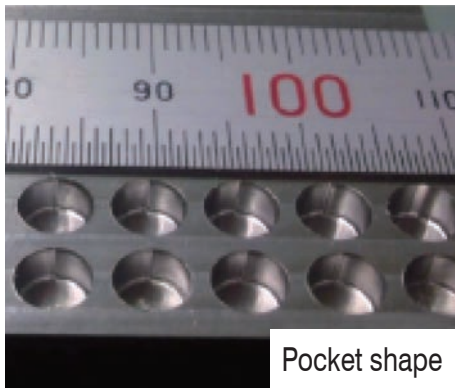
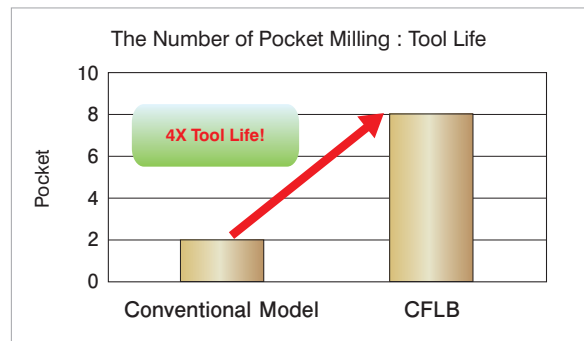
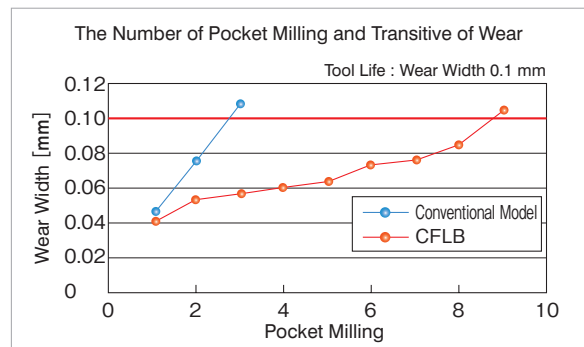
| WORK MATERIAL |                       |                       | TITANIUM ALLOYS<br>STAINLESS STEELS<br>Ti-6Al-4V / SUS etc. |                    |                        |                         | HEAT RESISTANT ALLOYS<br>Inconel718 |                    |                        |                         |
|---------------|-----------------------|-----------------------|---|--------------------|------------------------|-------------------------|-------------------------------------|--------------------|------------------------|-------------------------|
| Coolant       |                       |                       | WET   |                    |                        |                         | WET                                 |                    |                        |                         |
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )                          | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 3040-100      | R2                    | 10                    | 12,000  | 4,000              | 0.2                    | 0.87                    | 6,000                               | 1,000              | 0.2                    | 0.85                    |
| 3040-120      |                       | 12                    | 12,000  | 4,000              | 0.2                    | 0.87                    | 6,000                               | 1,000              | 0.2                    | 0.85                    |
| 3040-160      |                       | 16                    | 10,800  | 3,600              | 0.2                    | 0.87                    | 5,400                               | 900                | 0.2                    | 0.85                    |
| 3040-200      |                       | 20                    | 9,000   | 3,000              | 0.2                    | 0.87                    | 4,500                               | 750                | 0.17                   | 0.76                    |
| 3040-250      |                       | 25                    | 6,600   | 2,200              | 0.16                   | 0.78                    | 2,700                               | 400                | 0.14                   | 0.68                    |
| 3040-300      |                       | 30                    | 4,800   | 1,400              | 0.1                    | 0.62                    | 2,100                               | 300                | 0.12                   | 0.63                    |
| 3060-200      | R3                    | 20                    | 8,000   | 4,000              | 0.3                    | 1.3                     | 3,600                               | 900                | 0.3                    | 1.3                     |
| 3060-250      |                       | 25                    | 7,000   | 3,500              | 0.3                    | 1.3                     | 3,300                               | 820                | 0.27                   | 1.2                     |
| 3060-300      |                       | 30                    | 6,000   | 3,000              | 0.3                    | 1.3                     | 3,000                               | 750                | 0.25                   | 1.17                    |
| 3060-350      |                       | 35                    | 5,000   | 2,500              | 0.25                   | 1.15                    | 2,400                               | 570                | 0.23                   | 1.1                     |
| 3060-400      |                       | 40                    | 4,000   | 2,000              | 0.2                    | 1.05                    | 1,800                               | 400                | 0.21                   | 1.04                    |

## Tool Life Comparison with Conventional Model (2 flutes) R0.3 x EL3 mm S50C

### S50C Pocket Milling

#### ■ Milling Conditions

|                 |                            |
|-----------------|----------------------------|
| Spindle Speed   | 30,000 min <sup>-1</sup>   |
| Feed Rate       | 1,000 mm/min               |
| $a_p$           | 0.03 mm                    |
| $a_e$           | 0.13 mm                    |
| Coolant         | Air Blow (Through Spindle) |
| Overhang Length | 12 mm                      |
| Pocket Size     | $\phi 5 \times 3$ mm       |
| Cycle Time      | 14 min/pocket              |



$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.1~R2

# HTNB



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●      | ●      | ●      |        | ○         |                 |          | ●      |          |                       | ○               | ○                     |                  |                                       |

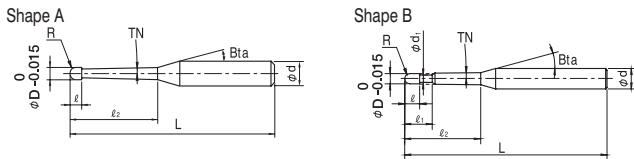
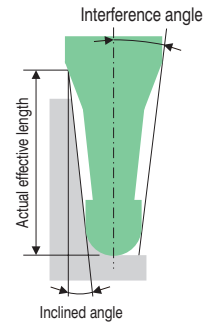
Total 245 models

| Model Number    | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Shape | Suggested Retail Price ¥ |
|-----------------|-----------------------|---------------------|----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|-------|--------------------------|
| HTNB 2002-015-1 | R0.1                  | 30°                 | 1.5                  | —                         | 0.16                 | —                        | 16°                   | 50               | 4                       | A     | 11,520                   |
| HTNB 2002-020-1 |                       |                     | 2                    |                           |                      |                          |                       | 50               | 4                       |       | 12,120                   |
| HTNB 2002-030-1 |                       |                     | 3                    |                           |                      |                          |                       | 50               | 4                       |       | 14,400                   |
| HTNB 2002-015-2 |                       | 1°                  | 1.5                  |                           |                      |                          |                       | 50               | 4                       |       | 11,520                   |
| HTNB 2002-020-2 |                       |                     | 2                    |                           |                      |                          |                       | 50               | 4                       |       | 12,120                   |
| HTNB 2002-030-2 |                       |                     | 3                    |                           |                      |                          |                       | 50               | 4                       |       | 14,400                   |
| HTNB 2002-015-3 |                       | 1°30'               | 1.5                  |                           |                      |                          |                       | 50               | 4                       |       | 11,520                   |
| HTNB 2002-020-3 |                       |                     | 2                    |                           |                      |                          |                       | 50               | 4                       |       | 12,120                   |
| HTNB 2002-030-3 |                       |                     | 3                    |                           |                      |                          |                       | 50               | 4                       |       | 14,400                   |
| HTNB 2003-020-1 |                       | R0.15               | 30°                  |                           |                      |                          |                       | 2                | —                       |       | 0.24                     |
| HTNB 2003-030-1 | 3                     |                     |                      | 50                        | 4                    | 12,120                   |                       |                  |                         |       |                          |
| HTNB 2003-020-2 | 1°                    |                     |                      | 2                         | 50                   | 4                        | 11,520                |                  |                         |       |                          |
| HTNB 2003-030-2 |                       |                     | 3                    | 50                        | 4                    | 12,120                   |                       |                  |                         |       |                          |
| HTNB 2003-020-3 |                       |                     | 1°30'                | 2                         | 50                   | 4                        | 11,520                |                  |                         |       |                          |
| HTNB 2003-030-3 | 3                     |                     |                      | 50                        | 4                    | 12,120                   |                       |                  |                         |       |                          |
| HTNB 2004-030-1 | R0.2                  | 30°                 |                      | 3                         | —                    | 0.32                     | —                     | 16°              | 50                      | 4     | A                        |
| HTNB 2004-040-1 |                       |                     | 4                    | 50                        |                      |                          |                       |                  | 4                       | 8,880 |                          |
| HTNB 2004-060-1 |                       |                     | 6                    | 50                        |                      |                          |                       |                  | 4                       | 9,600 |                          |
| HTNB 2004-030-2 |                       | 1°                  | 3                    | 50                        |                      |                          |                       |                  | 4                       | 8,880 |                          |
| HTNB 2004-040-2 |                       |                     | 4                    | 50                        |                      |                          |                       |                  | 4                       | 8,880 |                          |
| HTNB 2004-060-2 |                       |                     | 6                    | 50                        |                      |                          |                       |                  | 4                       | 9,600 |                          |
| HTNB 2004-030-3 |                       | 1°30'               | 3                    | 50                        |                      |                          |                       |                  | 4                       | 8,880 |                          |
| HTNB 2004-040-3 |                       |                     | 4                    | 50                        |                      |                          |                       |                  | 4                       | 8,880 |                          |
| HTNB 2004-060-3 |                       |                     | 6                    | 50                        |                      |                          |                       |                  | 4                       | 9,600 |                          |

## Features

Taper Neck design offers high rigidity.  
 Stable milling and excellent surface even on deep milling.  
 HARDMAX coat offers heat resistance, toughness and lubricity at a high level.  
 Suitable for hard materials up to 65HRC.

The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.



Unit (mm)

| Model Number    | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Interference Angle | Effective Length by Inclined Angles<br>— : Interference |      |       |      |      |
|-----------------|-----------------------|---------------------|----------------------|--------------------|---|------|-------|------|------|
|                 |                       |                     |                      |                    | 30°   | 1°   | 1°30' | 2°   | 3°   |
| HTNB 2002-015-1 | RO.1                  | 30°                 | 1.5                  | 13.36°             | —   | 1.50 | 1.55  | 1.60 | 1.72 |
| HTNB 2002-020-1 |                       |                     | 2                    | 12.63°             | —   | 2.01 | 2.08  | 2.15 | 2.31 |
| HTNB 2002-030-1 |                       |                     | 3                    | 11.37°             | —   | 3.05 | 3.15  | 3.26 | 3.50 |
| HTNB 2002-015-2 |                       | 1°                  | 1.5                  | 13.41°             | —   | —    | 1.51  | 1.56 | 1.68 |
| HTNB 2002-020-2 |                       |                     | 2                    | 12.69°             | —   | —    | 2.03  | 2.10 | 2.25 |
| HTNB 2002-030-2 |                       |                     | 3                    | 11.46°             | —   | —    | 3.06  | 3.17 | 3.40 |
| HTNB 2002-015-3 |                       | 1°30'               | 1.5                  | 13.46°             | —   | —    | —     | 1.53 | 1.64 |
| HTNB 2002-020-3 |                       |                     | 2                    | 12.76°             | —   | —    | —     | 2.04 | 2.19 |
| HTNB 2002-030-3 |                       |                     | 3                    | 11.56°             | —   | —    | —     | 3.08 | 3.31 |
| HTNB 2003-020-1 | RO.15                 | 30°                 | 2                    | 12.62°             | —   | 2.01 | 2.08  | 2.15 | 2.30 |
| HTNB 2003-030-1 |                       |                     | 3                    | 11.34°             | —   | 3.05 | 3.15  | 3.25 | 3.49 |
| HTNB 2003-020-2 |                       | 1°                  | 2                    | 12.68°             | —   | —    | 2.03  | 2.10 | 2.25 |
| HTNB 2003-030-2 |                       |                     | 3                    | 11.43°             | —   | —    | 3.06  | 3.17 | 3.40 |
| HTNB 2003-020-3 |                       | 1°30'               | 2                    | 12.75°             | —   | —    | —     | 2.05 | 2.19 |
| HTNB 2003-030-3 |                       |                     | 3                    | 11.52°             | —   | —    | —     | 3.08 | 3.31 |
| HTNB 2004-030-1 | RO.2                  | 30°                 | 3                    | 11.30°             | —   | 3.04 | 3.14  | 3.25 | 3.48 |
| HTNB 2004-040-1 |                       |                     | 4                    | 10.23°             | —   | 4.08 | 4.21  | 4.35 | 4.67 |
| HTNB 2004-060-1 |                       |                     | 6                    | 8.60°              | —   | 6.14 | 6.34  | 6.56 | 7.04 |
| HTNB 2004-030-2 |                       | 1°                  | 3                    | 11.38°             | —   | —    | 3.06  | 3.17 | 3.39 |
| HTNB 2004-040-2 |                       |                     | 4                    | 10.33°             | —   | —    | 4.10  | 4.23 | 4.54 |
| HTNB 2004-060-2 |                       |                     | 6                    | 8.72°              | —   | —    | 6.16  | 6.37 | 6.84 |
| HTNB 2004-030-3 |                       | 1°30'               | 3                    | 11.48°             | —   | —    | —     | 3.08 | 3.30 |
| HTNB 2004-040-3 |                       |                     | 4                    | 10.44°             | —   | —    | —     | 4.12 | 4.42 |
| HTNB 2004-060-3 |                       |                     | 6                    | 8.84°              | —   | —    | —     | 6.19 | 6.64 |

Next Page →

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral  
V Cutter

Spiral  
V Cutter

Drill

Drill

Technical Data

Technical Data

## 2 Flutes HARDMAX

| Model Number     | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Shape | Suggested Retail Price ¥ |
|------------------|-----------------------|---------------------|----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|-------|--------------------------|
| HTNB 2005-040-1  | R0.25                 | 30°                 | 4                    | —                         | 0.4                  | —                        | 16°                   | 50               | 4                       | A     | 8,400                    |
| HTNB 2005-060-1  |                       |                     | 6                    |                           |                      |                          |                       | 8,880            |                         |       |                          |
| HTNB 2005-080-1  |                       |                     | 8                    |                           |                      |                          |                       | 8,880            |                         |       |                          |
| HTNB 2005-100-1  |                       |                     | 10                   |                           |                      |                          |                       | 9,600            |                         |       |                          |
| HTNB 2005-040-2  |                       | 1°                  | 1°                   |                           |                      |                          |                       | 4                | 8,400                   |       |                          |
| HTNB 2005-060-2  |                       |                     |                      |                           |                      |                          |                       | 6                | 8,880                   |       |                          |
| HTNB 2005-080-2  |                       |                     |                      |                           |                      |                          |                       | 8                | 8,880                   |       |                          |
| HTNB 2005-100-2  |                       |                     |                      |                           |                      |                          |                       | 10               | 9,600                   |       |                          |
| HTNB 2005-040-3  |                       | 1°30'               | 1°30'                |                           |                      |                          |                       | 4                | 8,640                   |       |                          |
| HTNB 2005-060-3  |                       |                     |                      |                           |                      |                          |                       | 6                | 8,880                   |       |                          |
| HTNB 2005-080-3  |                       |                     |                      |                           |                      |                          |                       | 8                | 8,880                   |       |                          |
| HTNB 2005-100-3  |                       |                     |                      |                           |                      |                          |                       | 10               | 9,600                   |       |                          |
| HTNB 2006-040-1  | R0.3                  | 30°                 | 4                    | 0.9                       | 0.48                 | 0.56                     | 16°                   | 50               | 4                       | B     | 8,280                    |
| HTNB 2006-060-1  |                       |                     | 6                    |                           |                      |                          |                       | 8,520            |                         |       |                          |
| HTNB 2006-080-1  |                       |                     | 8                    |                           |                      |                          |                       | 8,520            |                         |       |                          |
| HTNB 2006-100-1  |                       |                     | 10                   |                           |                      |                          |                       | 8,640            |                         |       |                          |
| HTNB 2006-120-1  |                       |                     | 12                   |                           |                      |                          |                       | 9,360            |                         |       |                          |
| HTNB 2006-140-1  |                       |                     | 14                   |                           |                      |                          |                       | 9,360            |                         |       |                          |
| HTNB 2006-160-1  |                       |                     | 16                   |                           |                      |                          |                       | 9,360            |                         |       |                          |
| HTNB 2006-200-1  |                       |                     | 20                   |                           |                      |                          |                       | 12,500           |                         |       |                          |
| HTNB 2006-040-2  |                       | 1°                  | 1°                   |                           |                      |                          |                       | 4                | 8,280                   |       |                          |
| HTNB 2006-060-2  |                       |                     |                      |                           |                      |                          |                       | 6                | 8,520                   |       |                          |
| HTNB 2006-080-2  |                       |                     |                      |                           |                      |                          |                       | 8                | 8,520                   |       |                          |
| HTNB 2006-100-2  |                       |                     |                      |                           |                      |                          |                       | 10               | 8,640                   |       |                          |
| HTNB 2006-120-2  |                       |                     |                      |                           |                      |                          |                       | 12               | 9,360                   |       |                          |
| HTNB 2006-140-2  |                       |                     |                      |                           |                      |                          |                       | 14               | 9,360                   |       |                          |
| HTNB 2006-160-2  |                       |                     |                      |                           |                      |                          |                       | 16               | 9,360                   |       |                          |
| HTNB 2006-200-2  |                       |                     |                      |                           |                      |                          |                       | 20               | 12,500                  |       |                          |
| HTNB 2006-040-3  |                       | 1°30'               | 1°30'                |                           |                      |                          |                       | 4                | 8,280                   |       |                          |
| HTNB 2006-060-3  |                       |                     |                      |                           |                      |                          |                       | 6                | 8,520                   |       |                          |
| HTNB 2006-080-3  |                       |                     |                      |                           |                      |                          |                       | 8                | 8,520                   |       |                          |
| HTNB 2006-100-3  |                       |                     |                      |                           |                      |                          |                       | 10               | 8,640                   |       |                          |
| HTNB 2006-120-3  | 12                    |                     |                      | 9,360                     |                      |                          |                       |                  |                         |       |                          |
| HTNB 2006-140-3  | 14                    |                     |                      | 9,360                     |                      |                          |                       |                  |                         |       |                          |
| HTNB 2006-160-3  | 16                    |                     |                      | 9,360                     |                      |                          |                       |                  |                         |       |                          |
| HTNB 2006-200-3  | 20                    |                     |                      | 12,500                    |                      |                          |                       |                  |                         |       |                          |
| HTNB 2006-080-4  | 2°                    | 2°                  | 8                    | 8,520                     |                      |                          |                       |                  |                         |       |                          |
| HTNB 2006-120-4  |                       |                     | 12                   | 9,360                     |                      |                          |                       |                  |                         |       |                          |
| HTNB 2006-200-4  |                       |                     | 20                   | 12,500                    |                      |                          |                       |                  |                         |       |                          |
| HTNB 2006-080-6  |                       |                     | 3°                   | 3°                        | 8                    | 8,520                    |                       |                  |                         |       |                          |
| HTNB 2006-120-6  | 12                    | 9,360               |                      |                           |                      |                          |                       |                  |                         |       |                          |
| HTNB 2006-200-6  | 20                    | 12,500              |                      |                           |                      |                          |                       |                  |                         |       |                          |
| HTNB 2006-120-10 | 5°                    | 5°                  |                      |                           | 12                   | 9,360                    |                       |                  |                         |       |                          |
| HTNB 2006-200-10 |                       |                     | 20                   | 12,500                    |                      |                          |                       |                  |                         |       |                          |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Unit (mm)

| Model Number     | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Interference Angle | Effective Length by Inclined Angles<br>— : Interference |       |       |       |       |       |
|------------------|-----------------------|---------------------|----------------------|--------------------|---|-------|-------|-------|-------|-------|
|                  |                       |                     |                      |                    | 30°   | 1°    | 1°30' | 2°    | 3°    |       |
| HTNB 2005-040-1  | R0.25                 | 30°                 | 4                    | 10.17°             | —   | 4.08  | 4.21  | 4.35  | 4.66  |       |
| HTNB 2005-060-1  |                       |                     | 6                    | 8.52°              | —   | 6.14  | 6.34  | 6.55  | 7.03  |       |
| HTNB 2005-080-1  |                       |                     | 8                    | 7.33°              | —   | 8.21  | 8.48  | 8.76  | 9.41  |       |
| HTNB 2005-100-1  |                       |                     | 10                   | 6.43°              | —   | 10.27 | 10.61 | 10.97 | 11.78 |       |
| HTNB 2005-040-2  |                       | 1°                  | 30°                  | 4                  | 10.27°  | —     | —     | 4.10  | 4.23  | 4.54  |
| HTNB 2005-060-2  |                       |                     |                      | 6                  | 8.64°   | —     | —     | 6.16  | 6.37  | 6.84  |
| HTNB 2005-080-2  |                       |                     |                      | 8                  | 7.45°   | —     | —     | 8.23  | 8.51  | 9.13  |
| HTNB 2005-100-2  |                       |                     |                      | 10                 | 6.55°   | —     | —     | 10.30 | 10.65 | 11.43 |
| HTNB 2005-040-3  |                       | 1°30'               | 30°                  | 4                  | 10.38°  | —     | —     | —     | 4.12  | 4.41  |
| HTNB 2005-060-3  |                       |                     |                      | 6                  | 8.76°   | —     | —     | —     | 6.19  | 6.64  |
| HTNB 2005-080-3  |                       |                     |                      | 8                  | 7.57°   | —     | —     | —     | 8.26  | 8.86  |
| HTNB 2005-100-3  |                       |                     |                      | 10                 | 6.67°   | —     | —     | —     | 10.33 | 11.09 |
| HTNB 2006-040-1  | R0.3                  | 30°                 | 4                    | 10.10°             | —   | 4.08  | 4.21  | 4.34  | 4.65  |       |
| HTNB 2006-060-1  |                       |                     | 6                    | 8.44°              | —   | 6.14  | 6.34  | 6.55  | 7.03  |       |
| HTNB 2006-080-1  |                       |                     | 8                    | 7.24°              | —   | 8.21  | 8.47  | 8.76  | 9.40  |       |
| HTNB 2006-100-1  |                       |                     | 10                   | 6.33°              | —   | 10.27 | 10.61 | 10.97 | 11.77 |       |
| HTNB 2006-120-1  |                       |                     | 12                   | 5.63°              | —   | 12.34 | 12.74 | 13.18 | 14.14 |       |
| HTNB 2006-140-1  |                       |                     | 14                   | 5.07°              | —   | 14.39 | 14.87 | 15.37 | 16.51 |       |
| HTNB 2006-160-1  |                       |                     | 16                   | 4.61°              | —   | 16.46 | 17.01 | 17.59 | 18.89 |       |
| HTNB 2006-200-1  |                       |                     | 20                   | 3.90°              | —   | 20.60 | 21.28 | 22.01 | 23.64 |       |
| HTNB 2006-040-2  |                       | 1°                  | 30°                  | 4                  | 10.21°  | —     | —     | 4.10  | 4.23  | 4.53  |
| HTNB 2006-060-2  |                       |                     |                      | 6                  | 8.55°   | —     | —     | 6.17  | 6.37  | 6.83  |
| HTNB 2006-080-2  |                       |                     |                      | 8                  | 7.36°   | —     | —     | 8.23  | 8.51  | 9.13  |
| HTNB 2006-100-2  |                       |                     |                      | 10                 | 6.45°   | —     | —     | 10.30 | 10.65 | 11.43 |
| HTNB 2006-120-2  |                       |                     |                      | 12                 | 5.74°   | —     | —     | 12.37 | 12.79 | 13.72 |
| HTNB 2006-140-2  |                       |                     |                      | 14                 | 5.18°   | —     | —     | 14.43 | 14.93 | 16.03 |
| HTNB 2006-160-2  |                       |                     |                      | 16                 | 4.71°   | —     | —     | 16.50 | 17.07 | 18.32 |
| HTNB 2006-200-2  |                       |                     |                      | 20                 | 3.99°   | —     | —     | 20.64 | 21.34 | 22.92 |
| HTNB 2006-040-3  |                       | 1°30'               | 30°                  | 4                  | 10.31°  | —     | —     | —     | 4.12  | 4.41  |
| HTNB 2006-060-3  |                       |                     |                      | 6                  | 8.67°   | —     | —     | —     | 6.19  | 6.64  |
| HTNB 2006-080-3  |                       |                     |                      | 8                  | 7.48°   | —     | —     | —     | 8.26  | 8.86  |
| HTNB 2006-100-3  |                       |                     |                      | 10                 | 6.57°   | —     | —     | —     | 10.34 | 11.09 |
| HTNB 2006-120-3  |                       |                     |                      | 12                 | 5.86°   | —     | —     | —     | 12.40 | 13.31 |
| HTNB 2006-140-3  |                       |                     |                      | 14                 | 5.29°   | —     | —     | —     | 14.46 | 15.52 |
| HTNB 2006-160-3  |                       |                     |                      | 16                 | 4.82°   | —     | —     | —     | 16.54 | 17.76 |
| HTNB 2006-200-3  |                       |                     |                      | 20                 | 4.09°   | —     | —     | —     | 20.67 | 22.19 |
| HTNB 2006-080-4  | 2°                    | 30°                 | 8                    | 7.60°              | —   | —     | —     | 8.59  |       |       |
| HTNB 2006-120-4  |                       |                     | 12                   | 5.98°              | —   | —     | —     | —     | 12.89 |       |
| HTNB 2006-200-4  | 3°                    | 30°                 | 20                   | 4.19°              | —   | —     | —     | 21.49 |       |       |
| HTNB 2006-080-6  |                       |                     | 8                    | 7.86°              | —   | —     | —     | —     | —     |       |
| HTNB 2006-120-6  | 5°                    | 30°                 | 12                   | 6.23°              | —   | —     | —     | —     |       |       |
| HTNB 2006-200-6  |                       |                     | 20                   | 4.41°              | —   | —     | —     | —     | —     |       |
| HTNB 2006-120-10 | 5°                    | 30°                 | 12                   | 6.82°              | —   | —     | —     | —     |       |       |
| HTNB 2006-200-10 |                       |                     | 20                   | 4.92°              | —   | —     | —     | —     | —     |       |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

| Model Number    | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle B $\alpha$ | Overall Length L | Shank Diameter $\phi d$ | Shape | Suggested Retail Price ¥ |
|-----------------|-----------------------|---------------------|----------------------|---------------------------|----------------------|--------------------------|------------------------------|------------------|-------------------------|-------|--------------------------|
| HTNB 2008-060-1 | RO.4                  | 30°                 | 6                    | 1.2                       | 0.64                 | 0.76                     | 16°                          | 50               | 4                       | B     | 8,880                    |
| HTNB 2008-080-1 |                       |                     | 8                    |                           |                      |                          |                              | 50               | 4                       |       | 8,880                    |
| HTNB 2008-120-1 |                       |                     | 12                   |                           |                      |                          |                              | 60               | 4                       |       | 9,360                    |
| HTNB 2008-160-1 |                       |                     | 16                   |                           |                      |                          |                              | 60               | 4                       |       | 11,500                   |
| HTNB 2008-060-2 |                       | 1°                  | 6                    |                           |                      |                          |                              | 50               | 4                       |       | 8,880                    |
| HTNB 2008-080-2 |                       |                     | 8                    |                           |                      |                          |                              | 50               | 4                       |       | 8,880                    |
| HTNB 2008-120-2 |                       |                     | 12                   |                           |                      |                          |                              | 60               | 4                       |       | 9,360                    |
| HTNB 2008-160-2 |                       |                     | 16                   |                           |                      |                          |                              | 60               | 4                       |       | 11,500                   |
| HTNB 2008-060-3 |                       | 1°30'               | 6                    |                           |                      |                          |                              | 50               | 4                       |       | 8,880                    |
| HTNB 2008-080-3 |                       |                     | 8                    |                           |                      |                          |                              | 50               | 4                       |       | 8,880                    |
| HTNB 2008-120-3 |                       |                     | 12                   |                           |                      |                          |                              | 60               | 4                       |       | 9,360                    |
| HTNB 2008-160-3 |                       |                     | 16                   |                           |                      |                          |                              | 60               | 4                       |       | 11,500                   |
| HTNB 2010-060-1 | RO.5                  | 30°                 | 6                    | 1.5                       | 0.8                  | 0.95                     | 16°                          | 50               | 4                       | B     | 7,560                    |
| HTNB 2010-080-1 |                       |                     | 8                    |                           |                      |                          |                              | 50               | 4                       |       | 7,560                    |
| HTNB 2010-100-1 |                       |                     | 10                   |                           |                      |                          |                              | 50               | 4                       |       | 7,560                    |
| HTNB 2010-120-1 |                       |                     | 12                   |                           |                      |                          |                              | 50               | 4                       |       | 7,560                    |
| HTNB 2010-140-1 |                       |                     | 14                   |                           |                      |                          |                              | 50               | 4                       |       | 7,560                    |
| HTNB 2010-160-1 |                       |                     | 16                   |                           |                      |                          |                              | 50               | 4                       |       | 7,560                    |
| HTNB 2010-180-1 |                       | 18                  | 50                   |                           |                      |                          |                              | 4                | 7,560                   |       |                          |
| HTNB 2010-200-1 |                       | 20                  | 60                   |                           |                      |                          |                              | 4                | 9,600                   |       |                          |
| HTNB 2010-220-1 |                       | 22                  | 60                   |                           |                      |                          |                              | 4                | 9,600                   |       |                          |
| HTNB 2010-260-1 |                       | 26                  | 65                   |                           |                      |                          |                              | 4                | 10,080                  |       |                          |
| HTNB 2010-300-1 |                       | 30                  | 70                   |                           |                      |                          |                              | 4                | 10,560                  |       |                          |
| HTNB 2010-320-1 |                       | 32                  | 70                   |                           |                      |                          |                              | 4                | 10,560                  |       |                          |
| HTNB 2010-360-1 | 36                    | 80                  | 4                    | 11,040                    |                      |                          |                              |                  |                         |       |                          |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



Unit (mm)

| Model Number    | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Interference Angle | Effective Length by Inclined Angles<br>— : Interference |       |                 |       |                 |
|-----------------|-----------------------|---------------------|----------------------|--------------------|---|-------|-----------------|-------|-----------------|
|                 |                       |                     |                      |                    | 30°   | 1°    | 1°30'           | 2°    | 3°              |
| HTNB 2008-060-1 | RO.4                  | 30°                 | 6                    | 8.26°              | —   | 6.14  | 6.34            | 6.54  | 7.01            |
| HTNB 2008-080-1 |                       |                     | 8                    | 7.04°              | —   | 8.21  | 8.47            | 8.75  | 9.38            |
| HTNB 2008-120-1 |                       |                     | 12                   | 5.44°              | —   | 12.33 | 12.74           | 13.17 | 14.13           |
| HTNB 2008-160-1 |                       |                     | 16                   | 4.43°              | —   | 16.47 | 17.01           | 17.59 | 18.88           |
| HTNB 2008-060-2 |                       | 1°                  | 6                    | 8.37°              | —   | —     | 6.17            | 6.37  | 6.82            |
| HTNB 2008-080-2 |                       |                     | 8                    | 7.16°              | —   | —     | 8.23            | 8.51  | 9.12            |
| HTNB 2008-120-2 |                       |                     | 12                   | 5.55°              | —   | —     | 12.37           | 12.79 | 13.72           |
| HTNB 2008-160-2 |                       |                     | 16                   | 4.53°              | —   | —     | 16.50           | 17.06 | 18.31           |
| HTNB 2008-060-3 |                       | 1°30'               | 6                    | 8.49°              | —   | —     | —               | 6.20  | 6.64            |
| HTNB 2008-080-3 |                       |                     | 8                    | 7.28°              | —   | —     | —               | 8.26  | 8.86            |
| HTNB 2008-120-3 |                       |                     | 12                   | 5.67°              | —   | —     | —               | 12.40 | 13.30           |
| HTNB 2008-160-3 |                       |                     | 16                   | 4.63°              | —   | —     | —               | 16.54 | 17.75           |
| HTNB 2010-060-1 | RO.5                  | 30°                 | 6                    | 8.06°              | —   | 6.14  | 6.33            | 6.54  | 7.00            |
| HTNB 2010-080-1 |                       |                     | 8                    | 6.84°              | —   | 8.21  | 8.47            | 8.75  | 9.37            |
| HTNB 2010-100-1 |                       |                     | 10                   | 5.93°              | —   | 10.27 | 10.60           | 10.96 | 11.74           |
| HTNB 2010-120-1 |                       |                     | 12                   | 5.24°              | —   | 12.33 | 12.73           | 13.16 | 14.11           |
| HTNB 2010-140-1 |                       |                     | 14                   | 4.69°              | —   | 14.39 | 14.85           | 15.35 | 16.47           |
| HTNB 2010-160-1 |                       |                     | 16                   | 4.25°              | —   | 16.46 | 17.00           | 17.58 | 18.86           |
| HTNB 2010-180-1 |                       |                     | 18                   | 3.88°              | —   | 18.51 | 19.12           | 19.77 | 21.21           |
| HTNB 2010-200-1 |                       |                     | 20                   | 3.57°              | —   | 20.60 | 21.27           | 22.00 | 23.61           |
| HTNB 2010-220-1 |                       |                     | 22                   | 3.31°              | —   | 22.66 | 23.41           | 24.20 | 25.98           |
| HTNB 2010-260-1 |                       |                     | 26                   | 2.88°              | —   | 26.79 | 27.67           | 28.62 | No Interference |
| HTNB 2010-300-1 |                       |                     | 30                   | 2.55°              | —   | 30.90 | 31.93           | 33.02 | No Interference |
| HTNB 2010-320-1 |                       |                     | 32                   | 2.41°              | —   | 32.98 | 34.07           | 35.24 | No Interference |
| HTNB 2010-360-1 | 36                    | 2.18°               | —                    | 37.11              | 38.34   | 39.66 | No Interference |       |                 |

Next Page ➔

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

| Model Number     | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Shape | Suggested Retail Price ¥ |       |        |
|------------------|-----------------------|---------------------|----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|-------|--------------------------|-------|--------|
| HTNB 2010-060-2  | RO.5                  | 1°                  | 6                    | 1.5                       | 0.8                  | 0.95                     | 16°                   | 50               | 4                       | B     | 7,560                    |       |        |
| HTNB 2010-080-2  |                       |                     | 8                    |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-100-2  |                       |                     | 10                   |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-120-2  |                       |                     | 12                   |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-140-2  |                       |                     | 14                   |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-160-2  |                       |                     | 16                   |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-180-2  |                       |                     | 18                   |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-200-2  |                       |                     | 20                   |                           |                      |                          |                       | 60               | 4                       |       | 9,600                    |       |        |
| HTNB 2010-220-2  |                       |                     | 22                   |                           |                      |                          |                       | 60               | 4                       |       | 9,600                    |       |        |
| HTNB 2010-260-2  |                       |                     | 26                   |                           |                      |                          |                       | 65               | 4                       |       | 10,080                   |       |        |
| HTNB 2010-300-2  |                       |                     | 30                   |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |       |        |
| HTNB 2010-320-2  |                       |                     | 32                   |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |       |        |
| HTNB 2010-360-2  |                       |                     | 36                   |                           |                      |                          |                       | 80               | 4                       |       | 11,040                   |       |        |
| HTNB 2010-060-3  |                       |                     | 1°30'                |                           |                      |                          |                       | 6                | 50                      |       | 4                        | 7,560 |        |
| HTNB 2010-080-3  |                       | 8                   |                      |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-100-3  |                       | 10                  |                      |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-120-3  |                       | 12                  |                      |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-140-3  |                       | 14                  |                      |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-160-3  |                       | 16                  |                      |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-180-3  |                       | 18                  |                      |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-200-3  |                       | 20                  |                      |                           |                      |                          |                       | 60               | 4                       |       | 9,600                    |       |        |
| HTNB 2010-220-3  |                       | 22                  |                      |                           |                      |                          |                       | 60               | 4                       |       | 9,600                    |       |        |
| HTNB 2010-260-3  |                       | 26                  |                      |                           |                      |                          |                       | 65               | 4                       |       | 10,080                   |       |        |
| HTNB 2010-300-3  |                       | 30                  |                      |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |       |        |
| HTNB 2010-320-3  |                       | 32                  |                      |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |       |        |
| HTNB 2010-360-3  |                       | 36                  |                      |                           |                      |                          |                       | 80               | 4                       |       | 11,040                   |       |        |
| HTNB 2010-120-4  |                       | 2°                  |                      |                           |                      |                          |                       | 12               | 50                      |       | 4                        | 7,560 |        |
| HTNB 2010-160-4  |                       |                     | 16                   |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-200-4  |                       |                     | 20                   |                           |                      |                          |                       | 60               | 4                       |       | 9,600                    |       |        |
| HTNB 2010-300-4  |                       |                     | 30                   |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |       |        |
| HTNB 2010-120-6  |                       | 3°                  | 12                   |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-160-6  |                       |                     | 16                   |                           |                      |                          |                       | 50               | 4                       |       | 7,560                    |       |        |
| HTNB 2010-200-6  |                       |                     | 20                   |                           |                      |                          |                       | 60               | 4                       |       | 9,600                    |       |        |
| HTNB 2010-298-6  |                       |                     | 29.8                 |                           |                      |                          |                       | —                | 70                      |       | 4                        | C     | 10,560 |
| HTNB 2010-120-10 |                       | 5°                  | 12                   |                           |                      |                          |                       | 16°              | 50                      |       | 4                        | B     | 7,560  |
| HTNB 2010-200-10 |                       |                     | 20                   |                           |                      |                          |                       |                  | 70                      |       | 6                        |       | 9,600  |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Unit (mm)

| Model Number     | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Interference Angle | Effective Length by Inclined Angles<br>— : Interference |       |       |                 |                 |                 |
|------------------|-----------------------|---------------------|----------------------|--------------------|---|-------|-------|-----------------|-----------------|-----------------|
|                  |                       |                     |                      |                    | 30°   | 1°    | 1°30' | 2°              | 3°              |                 |
| HTNB 2010-060-2  | RO.5                  | 1°                  | 6                    | 8.17°              | —   | —     | 6.18  | 6.38            | 6.82            |                 |
| HTNB 2010-080-2  |                       |                     | 8                    | 6.95°              | —   | —     | 8.24  | 8.51            | 9.12            |                 |
| HTNB 2010-100-2  |                       |                     | 10                   | 6.04°              | —   | —     | 10.31 | 10.66           | 11.42           |                 |
| HTNB 2010-120-2  |                       |                     | 12                   | 5.35°              | —   | —     | 12.38 | 12.79           | 13.72           |                 |
| HTNB 2010-140-2  |                       |                     | 14                   | 4.79°              | —   | —     | 14.45 | 14.93           | 16.02           |                 |
| HTNB 2010-160-2  |                       |                     | 16                   | 4.34°              | —   | —     | 16.51 | 17.07           | 18.31           |                 |
| HTNB 2010-180-2  |                       |                     | 18                   | 3.97°              | —   | —     | 18.58 | 19.21           | 20.61           |                 |
| HTNB 2010-200-2  |                       |                     | 20                   | 3.65°              | —   | —     | 20.64 | 21.35           | 22.91           |                 |
| HTNB 2010-220-2  |                       |                     | 22                   | 3.39°              | —   | —     | 22.71 | 23.48           | 25.21           |                 |
| HTNB 2010-260-2  |                       |                     | 26                   | 2.95°              | —   | —     | 26.85 | 27.76           | No Interference |                 |
| HTNB 2010-300-2  |                       |                     | 30                   | 2.62°              | —   | —     | 30.97 | 32.03           | No Interference |                 |
| HTNB 2010-320-2  |                       |                     | 32                   | 2.48°              | —   | —     | 33.05 | 34.18           | No Interference |                 |
| HTNB 2010-360-2  |                       | 36                  | 2.24°                | —                  | —   | 37.18 | 38.46 | No Interference |                 |                 |
| HTNB 2010-060-3  |                       | 1°30'               | 1°30'                | 6                  | 8.28°   | —     | —     | —               | 6.21            | 6.65            |
| HTNB 2010-080-3  |                       |                     |                      | 8                  | 7.06°   | —     | —     | —               | 8.28            | 8.87            |
| HTNB 2010-100-3  |                       |                     |                      | 10                 | 6.16°   | —     | —     | —               | 10.35           | 11.10           |
| HTNB 2010-120-3  |                       |                     |                      | 12                 | 5.45°   | —     | —     | —               | 12.42           | 13.32           |
| HTNB 2010-140-3  |                       |                     |                      | 14                 | 4.90°   | —     | —     | —               | 14.47           | 15.52           |
| HTNB 2010-160-3  |                       |                     |                      | 16                 | 4.44°   | —     | —     | —               | 16.56           | 17.77           |
| HTNB 2010-180-3  |                       |                     |                      | 18                 | 4.06°   | —     | —     | —               | 18.61           | 19.97           |
| HTNB 2010-200-3  |                       |                     |                      | 20                 | 3.74°   | —     | —     | —               | 20.70           | 22.21           |
| HTNB 2010-220-3  |                       |                     |                      | 22                 | 3.47°   | —     | —     | —               | 22.77           | 24.44           |
| HTNB 2010-260-3  |                       |                     |                      | 26                 | 3.03°   | —     | —     | —               | 26.91           | 28.88           |
| HTNB 2010-300-3  |                       |                     |                      | 30                 | 2.69°   | —     | —     | —               | 31.03           | No Interference |
| HTNB 2010-320-3  |                       |                     |                      | 32                 | 2.55°   | —     | —     | —               | 33.11           | No Interference |
| HTNB 2010-360-3  |                       | 36                  | 2.30°                | —                  | —   | —     | 37.25 | No Interference |                 |                 |
| HTNB 2010-120-4  |                       | 2°                  | 2°                   | 12                 | 5.57°   | —     | —     | —               | 12.88           |                 |
| HTNB 2010-160-4  |                       |                     |                      | 16                 | 4.55°   | —     | —     | —               | 17.18           |                 |
| HTNB 2010-200-4  |                       |                     |                      | 20                 | 3.84°   | —     | —     | —               | 21.48           |                 |
| HTNB 2010-300-4  |                       |                     |                      | 30                 | 2.77°   | —     | —     | —               | No Interference |                 |
| HTNB 2010-120-6  |                       | 3°                  | 3°                   | 12                 | 5.82°   | —     | —     | —               | —               |                 |
| HTNB 2010-160-6  |                       |                     |                      | 16                 | 4.77°   | —     | —     | —               | —               |                 |
| HTNB 2010-200-6  |                       |                     |                      | 20                 | 4.05°   | —     | —     | —               | —               |                 |
| HTNB 2010-298-6  |                       |                     |                      | 29.8               | —   | —     | —     | —               | —               |                 |
| HTNB 2010-120-10 |                       | 5°                  | 5°                   | 12                 | 6.38°   | —     | —     | —               | —               |                 |
| HTNB 2010-200-10 |                       |                     |                      | 20                 | 6.35°   | —     | —     | —               | —               |                 |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Next Page ➡

| Model Number    | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Shape | Suggested Retail Price ¥ |       |
|-----------------|-----------------------|---------------------|----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|-------|--------------------------|-------|
| HTNB 2015-100-1 | R0.75                 | 30°                 | 10                   | 2.25                      | 1.2                  | 1.42                     | 16°                   | 60               | 4                       | B     | 7,920                    |       |
| HTNB 2015-120-1 |                       |                     | 12                   |                           |                      |                          |                       | 7,920            |                         |       |                          |       |
| HTNB 2015-160-1 |                       |                     | 16                   |                           |                      |                          |                       | 8,640            |                         |       |                          |       |
| HTNB 2015-200-1 |                       |                     | 20                   |                           |                      |                          |                       | 8,640            |                         |       |                          |       |
| HTNB 2015-220-1 |                       |                     | 22                   |                           |                      |                          |                       | 8,640            |                         |       |                          |       |
| HTNB 2015-260-1 |                       |                     | 26                   |                           |                      |                          |                       | 9,360            |                         |       |                          |       |
| HTNB 2015-300-1 |                       |                     | 30                   |                           |                      |                          |                       | 9,360            |                         |       |                          |       |
| HTNB 2015-360-1 |                       |                     | 36                   |                           |                      |                          |                       | 11,040           |                         |       |                          |       |
| HTNB 2015-100-2 |                       |                     | 1°                   |                           |                      |                          |                       | 10               | 60                      |       | 4                        | 7,920 |
| HTNB 2015-120-2 |                       | 12                  |                      |                           |                      |                          |                       | 60               | 4                       |       | 7,920                    |       |
| HTNB 2015-160-2 |                       | 16                  |                      |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |       |
| HTNB 2015-200-2 |                       | 20                  |                      |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |       |
| HTNB 2015-260-2 |                       | 26                  |                      |                           |                      |                          |                       | 70               | 4                       |       | 9,360                    |       |
| HTNB 2015-300-2 |                       | 30                  |                      |                           |                      |                          |                       | 70               | 4                       |       | 9,360                    |       |
| HTNB 2015-360-2 |                       | 36                  |                      |                           |                      |                          |                       | 80               | 4                       |       | 11,040                   |       |
| HTNB 2015-100-3 |                       | 1°30'               |                      |                           |                      |                          |                       | 10               | 60                      |       | 4                        | 7,920 |
| HTNB 2015-120-3 |                       |                     |                      |                           |                      |                          |                       | 12               | 60                      |       | 4                        | 7,920 |
| HTNB 2015-160-3 |                       |                     | 16                   |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |       |
| HTNB 2015-200-3 |                       |                     | 20                   |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |       |
| HTNB 2015-260-3 |                       |                     | 26                   |                           |                      |                          |                       | 70               | 4                       |       | 9,360                    |       |
| HTNB 2015-300-3 |                       |                     | 30                   |                           |                      |                          |                       | 70               | 4                       |       | 9,360                    |       |
| HTNB 2015-360-3 |                       |                     | 36                   |                           |                      |                          |                       | 80               | 4                       |       | 11,040                   |       |
| HTNB 2015-120-4 |                       |                     | 2°                   |                           |                      |                          |                       | 12               | 60                      |       | 4                        | 7,920 |
| HTNB 2015-160-4 |                       |                     |                      |                           |                      |                          |                       | 16               | 60                      |       | 4                        | 8,640 |
| HTNB 2015-200-4 |                       | 20                  |                      |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |       |
| HTNB 2015-300-4 |                       | 30                  |                      |                           |                      |                          |                       | 70               | 6                       |       | 11,040                   |       |
| HTNB 2015-120-6 |                       | 3°                  | 12                   |                           |                      |                          |                       | 60               | 4                       |       | 7,920                    |       |
| HTNB 2015-160-6 |                       |                     | 16                   |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |       |
| HTNB 2015-200-6 |                       |                     | 20                   |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |       |
| HTNB 2015-300-6 |                       |                     | 30                   |                           |                      |                          |                       | 70               | 6                       |       | 11,040                   |       |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Unit (mm)

| Model Number    | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Interference Angle | Effective Length by Inclined Angles<br>— : Interference |       |       |                 |                 |       |
|-----------------|-----------------------|---------------------|----------------------|--------------------|---|-------|-------|-----------------|-----------------|-------|
|                 |                       |                     |                      |                    | 30°   | 1°    | 1°30' | 2°              | 3°              |       |
| HTNB 2015-100-1 | R0.75                 | 30°                 | 10                   | 5.36°              | —   | 10.27 | 10.59 | 10.93           | 11.70           |       |
| HTNB 2015-120-1 |                       |                     | 12                   | 4.69°              | —   | 12.33 | 12.72 | 13.14           | 14.08           |       |
| HTNB 2015-160-1 |                       |                     | 16                   | 3.75°              | —   | 16.46 | 16.99 | 17.56           | 18.82           |       |
| HTNB 2015-200-1 |                       |                     | 20                   | 3.12°              | —   | 20.59 | 21.26 | 21.98           | 23.57           |       |
| HTNB 2015-220-1 |                       |                     | 22                   | 2.88°              | —   | 22.66 | 23.39 | 24.18           | No Interference |       |
| HTNB 2015-260-1 |                       |                     | 26                   | 2.50°              | —   | 26.79 | 27.66 | 28.60           | No Interference |       |
| HTNB 2015-300-1 |                       |                     | 30                   | 2.20°              | —   | 30.92 | 31.93 | 33.01           | No Interference |       |
| HTNB 2015-360-1 |                       |                     | 36                   | 1.87°              | —   | 37.11 | 38.33 | No Interference | No Interference |       |
| HTNB 2015-100-2 |                       |                     | 1°                   | 10                 | 5.46°   | —     | —     | 10.31           | 10.65           | 11.39 |
| HTNB 2015-120-2 |                       | 12                  |                      | 4.79°              | —   | —     | 12.38 | 12.78           | 13.69           |       |
| HTNB 2015-160-2 |                       | 16                  |                      | 3.83°              | —   | —     | 16.51 | 17.06           | 18.29           |       |
| HTNB 2015-200-2 |                       | 20                  |                      | 3.20°              | —   | —     | 20.65 | 21.34           | 22.89           |       |
| HTNB 2015-260-2 |                       | 26                  |                      | 2.56°              | —   | —     | 26.85 | 27.76           | No Interference |       |
| HTNB 2015-300-2 |                       | 30                  |                      | 2.26°              | —   | —     | 30.98 | 32.03           | No Interference |       |
| HTNB 2015-360-2 |                       | 36                  |                      | 1.92°              | —   | —     | 37.18 | No Interference | No Interference |       |
| HTNB 2015-100-3 |                       | 1°30'               |                      | 10                 | 5.57°   | —     | —     | —               | 10.36           | 11.09 |
| HTNB 2015-120-3 |                       |                     |                      | 12                 | 4.89°   | —     | —     | —               | 12.43           | 13.31 |
| HTNB 2015-160-3 |                       |                     | 16                   | 3.92°              | —   | —     | —     | 16.57           | 17.76           |       |
| HTNB 2015-200-3 |                       |                     | 20                   | 3.28°              | —   | —     | —     | 20.71           | 22.21           |       |
| HTNB 2015-260-3 |                       |                     | 26                   | 2.63°              | —   | —     | —     | 26.91           | No Interference |       |
| HTNB 2015-300-3 |                       |                     | 30                   | 2.32°              | —   | —     | —     | 31.05           | No Interference |       |
| HTNB 2015-360-3 |                       |                     | 36                   | 1.98°              | —   | —     | —     | No Interference | No Interference |       |
| HTNB 2015-120-4 |                       |                     | 2°                   | 12                 | 4.98°   | —     | —     | —               | —               | 12.90 |
| HTNB 2015-160-4 |                       |                     |                      | 16                 | 4.02°   | —     | —     | —               | —               | 17.20 |
| HTNB 2015-200-4 |                       | 20                  |                      | 3.36°              | —   | —     | —     | —               | 21.50           |       |
| HTNB 2015-300-4 |                       | 30                  |                      | 3.84°              | —   | —     | —     | —               | 32.25           |       |
| HTNB 2015-120-6 |                       | 3°                  | 12                   | 5.21°              | —   | —     | —     | —               | —               |       |
| HTNB 2015-160-6 |                       |                     | 16                   | 4.22°              | —   | —     | —     | —               | —               |       |
| HTNB 2015-200-6 |                       |                     | 20                   | 3.55°              | —   | —     | —     | —               | —               |       |
| HTNB 2015-300-6 |                       |                     | 30                   | 4.04°              | —   | —     | —     | —               | —               |       |

Next Page →

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
Radius  
Taper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
Ball  
Taper Neck  
BallTaper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## 2 Flutes HARDMAX

| Model Number    | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Shape | Suggested Retail Price ¥ |
|-----------------|-----------------------|---------------------|----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|-------|--------------------------|
| HTNB 2020-120-1 | R1                    | 30°                 | 12                   | 3                         | 1.6                  | 1.91                     | 16°                   | 60               | 4                       | B     | 8,100                    |
| HTNB 2020-160-1 |                       |                     | 16                   |                           |                      |                          |                       | 60               | 4                       |       | 8,100                    |
| HTNB 2020-200-1 |                       |                     | 20                   |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |
| HTNB 2020-220-1 |                       |                     | 22                   |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |
| HTNB 2020-240-1 |                       |                     | 24                   |                           |                      |                          |                       | 60               | 4                       |       | 9,600                    |
| HTNB 2020-260-1 |                       |                     | 26                   |                           |                      |                          |                       | 60               | 4                       |       | 9,600                    |
| HTNB 2020-280-1 |                       |                     | 28                   |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |
| HTNB 2020-300-1 |                       |                     | 30                   |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |
| HTNB 2020-320-1 |                       |                     | 32                   |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |
| HTNB 2020-340-1 |                       |                     | 34                   |                           |                      |                          |                       | 70               | 4                       |       | 11,040                   |
| HTNB 2020-360-1 |                       |                     | 36                   |                           |                      |                          |                       | 80               | 4                       |       | 11,040                   |
| HTNB 2020-400-1 |                       |                     | 40                   |                           |                      |                          |                       | 80               | 4                       |       | 12,480                   |
| HTNB 2020-100-2 |                       | 1°                  | 10                   |                           |                      |                          |                       | 60               | 4                       |       | 8,100                    |
| HTNB 2020-120-2 |                       |                     | 12                   |                           |                      |                          |                       | 60               | 4                       |       | 8,100                    |
| HTNB 2020-160-2 |                       |                     | 16                   |                           |                      |                          |                       | 60               | 4                       |       | 8,100                    |
| HTNB 2020-200-2 |                       |                     | 20                   |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |
| HTNB 2020-220-2 |                       |                     | 22                   |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |
| HTNB 2020-240-2 |                       |                     | 24                   |                           |                      |                          |                       | 60               | 4                       |       | 9,600                    |
| HTNB 2020-260-2 |                       |                     | 26                   |                           |                      |                          |                       | 60               | 4                       |       | 9,600                    |
| HTNB 2020-280-2 |                       |                     | 28                   |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |
| HTNB 2020-300-2 |                       |                     | 30                   |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |
| HTNB 2020-320-2 |                       |                     | 32                   |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |
| HTNB 2020-340-2 |                       |                     | 34                   |                           |                      |                          |                       | 70               | 4                       |       | 11,040                   |
| HTNB 2020-360-2 |                       |                     | 36                   |                           |                      |                          |                       | 80               | 4                       |       | 11,040                   |
| HTNB 2020-400-2 |                       | 40                  | 80                   |                           |                      |                          |                       | 4                | 13,100                  |       |                          |
| HTNB 2020-100-3 |                       | 1°30'               | 10                   |                           |                      |                          |                       | 60               | 4                       |       | 8,100                    |
| HTNB 2020-120-3 |                       |                     | 12                   |                           |                      |                          |                       | 60               | 4                       |       | 8,100                    |
| HTNB 2020-160-3 |                       |                     | 16                   |                           |                      |                          |                       | 60               | 4                       |       | 8,100                    |
| HTNB 2020-200-3 |                       |                     | 20                   |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |
| HTNB 2020-220-3 |                       |                     | 22                   |                           |                      |                          |                       | 60               | 4                       |       | 8,640                    |
| HTNB 2020-240-3 |                       |                     | 24                   |                           |                      |                          |                       | 60               | 4                       |       | 9,600                    |
| HTNB 2020-260-3 |                       |                     | 26                   |                           |                      |                          |                       | 60               | 4                       |       | 9,600                    |
| HTNB 2020-280-3 |                       |                     | 28                   |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |
| HTNB 2020-300-3 |                       |                     | 30                   |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |
| HTNB 2020-320-3 |                       |                     | 32                   |                           |                      |                          |                       | 70               | 4                       |       | 10,560                   |
| HTNB 2020-340-3 |                       |                     | 34                   |                           |                      |                          |                       | 70               | 4                       |       | 11,040                   |
| HTNB 2020-360-3 |                       |                     | 36                   |                           |                      |                          |                       | 80               | 4                       |       | 11,040                   |
| HTNB 2020-400-3 |                       | 40                  | 80                   |                           |                      |                          |                       | 4                | 13,100                  |       |                          |
| HTNB 2020-120-4 |                       | 2°                  | 12                   |                           |                      |                          |                       | 60               | 4                       |       | 8,100                    |
| HTNB 2020-160-4 |                       |                     | 16                   |                           |                      |                          |                       | 60               | 4                       |       | 8,100                    |
| HTNB 2020-200-4 | 20                    |                     | 60                   | 4                         | 8,640                |                          |                       |                  |                         |       |                          |
| HTNB 2020-300-4 | 30                    |                     | 70                   | 6                         | 11,440               |                          |                       |                  |                         |       |                          |
| HTNB 2020-400-4 | 40                    | 80                  | 6                    | 13,980                    |                      |                          |                       |                  |                         |       |                          |
| HTNB 2020-120-6 | 3°                    | 12                  | 60                   | 4                         | 8,100                |                          |                       |                  |                         |       |                          |
| HTNB 2020-160-6 |                       | 16                  | 60                   | 4                         | 8,100                |                          |                       |                  |                         |       |                          |
| HTNB 2020-200-6 |                       | 20                  | 60                   | 4                         | 8,640                |                          |                       |                  |                         |       |                          |
| HTNB 2020-300-6 |                       | 30                  | 70                   | 6                         | 11,440               |                          |                       |                  |                         |       |                          |
| HTNB 2020-400-6 | 40                    | 80                  | 6                    | 13,980                    |                      |                          |                       |                  |                         |       |                          |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

Unit (mm)

| Model Number    | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Interference Angle | Effective Length by Inclined Angles<br>— : Interference |       |                 |                 |                 |                 |       |
|-----------------|-----------------------|---------------------|----------------------|--------------------|---|-------|-----------------|-----------------|-----------------|-----------------|-------|
|                 |                       |                     |                      |                    | 30°   | 1°    | 1°30'           | 2°              | 3°              |                 |       |
| HTNB 2020-120-1 | R1                    | 30°                 | 12                   | 4.05°              | —   | 12.34 | 12.72           | 13.14           | 14.05           |                 |       |
| HTNB 2020-160-1 |                       |                     | 16                   | 3.19°              | —   | 16.47 | 16.99           | 17.55           | 18.80           |                 |       |
| HTNB 2020-200-1 |                       |                     | 20                   | 2.63°              | —   | 20.60 | 21.26           | 21.97           | No Interference |                 |       |
| HTNB 2020-220-1 |                       |                     | 22                   | 2.42°              | —   | 22.66 | 23.39           | 24.17           | No Interference |                 |       |
| HTNB 2020-240-1 |                       |                     | 24                   | 2.23°              | —   | 24.73 | 25.53           | 26.38           | No Interference |                 |       |
| HTNB 2020-260-1 |                       |                     | 26                   | 2.08°              | —   | 26.79 | 27.66           | 28.59           | No Interference |                 |       |
| HTNB 2020-280-1 |                       |                     | 28                   | 1.94°              | —   | 28.86 | 29.80           | No Interference | No Interference |                 |       |
| HTNB 2020-300-1 |                       |                     | 30                   | 1.83°              | —   | 30.92 | 31.93           | No Interference | No Interference |                 |       |
| HTNB 2020-320-1 |                       |                     | 32                   | 1.72°              | —   | 32.99 | 34.07           | No Interference | No Interference |                 |       |
| HTNB 2020-340-1 |                       |                     | 34                   | 1.63°              | —   | 35.05 | 36.20           | No Interference | No Interference |                 |       |
| HTNB 2020-360-1 |                       |                     | 36                   | 1.54°              | —   | 37.12 | 38.33           | No Interference | No Interference |                 |       |
| HTNB 2020-400-1 |                       |                     | 40                   | 1.40°              | —   | 41.25 | No Interference | No Interference | No Interference |                 |       |
| HTNB 2020-100-2 |                       |                     | 1°                   | 1°                 | 10  | 4.77° | —               | —               | 10.34           | 10.66           | 11.40 |
| HTNB 2020-120-2 |                       |                     |                      |                    | 12  | 4.13° | —               | —               | 12.40           | 12.80           | 13.69 |
| HTNB 2020-160-2 |                       | 16                  |                      |                    | 3.26°   | —     | —               | 16.53           | 17.08           | 18.29           |       |
| HTNB 2020-200-2 |                       | 20                  |                      |                    | 2.69°   | —     | —               | 20.67           | 21.35           | No Interference |       |
| HTNB 2020-220-2 |                       | 22                  |                      |                    | 2.48°   | —     | —               | 22.73           | 23.49           | No Interference |       |
| HTNB 2020-240-2 |                       | 24                  |                      |                    | 2.29°   | —     | —               | 24.80           | 25.63           | No Interference |       |
| HTNB 2020-260-2 |                       | 26                  |                      |                    | 2.13°   | —     | —               | 26.87           | 27.77           | No Interference |       |
| HTNB 2020-280-2 |                       | 28                  |                      |                    | 2.00°   | —     | —               | 28.94           | 29.91           | No Interference |       |
| HTNB 2020-300-2 |                       | 30                  |                      |                    | 1.88°   | —     | —               | 31.00           | No Interference | No Interference |       |
| HTNB 2020-320-2 |                       | 32                  |                      |                    | 1.77°   | —     | —               | 33.07           | No Interference | No Interference |       |
| HTNB 2020-340-2 |                       | 34                  |                      |                    | 1.67°   | —     | —               | 35.14           | No Interference | No Interference |       |
| HTNB 2020-360-2 |                       | 36                  |                      |                    | 1.59°   | —     | —               | 37.20           | No Interference | No Interference |       |
| HTNB 2020-400-2 |                       | 40                  |                      |                    | 1.44°   | —     | —               | No Interference | No Interference | No Interference |       |
| HTNB 2020-100-3 |                       | 1°30'               |                      |                    | 1°30'   | 10    | 4.83°           | —               | —               | 10.38           | 11.09 |
| HTNB 2020-120-3 |                       |                     | 12                   | 4.22°              |   | —     | —               | —               | 12.46           | 13.33           |       |
| HTNB 2020-160-3 |                       |                     | 16                   | 3.34°              |   | —     | —               | —               | 16.60           | 17.78           |       |
| HTNB 2020-200-3 |                       |                     | 20                   | 2.76°              |   | —     | —               | —               | 20.74           | No Interference |       |
| HTNB 2020-220-3 |                       |                     | 22                   | 2.54°              |   | —     | —               | —               | 22.81           | No Interference |       |
| HTNB 2020-240-3 |                       |                     | 24                   | 2.35°              |   | —     | —               | —               | 24.88           | No Interference |       |
| HTNB 2020-260-3 |                       |                     | 26                   | 2.19°              |   | —     | —               | —               | 26.95           | No Interference |       |
| HTNB 2020-280-3 |                       |                     | 28                   | 2.05°              |   | —     | —               | —               | 29.02           | No Interference |       |
| HTNB 2020-300-3 |                       |                     | 30                   | 1.93°              |   | —     | —               | —               | No Interference | No Interference |       |
| HTNB 2020-320-3 |                       |                     | 32                   | 1.82°              |   | —     | —               | —               | No Interference | No Interference |       |
| HTNB 2020-340-3 |                       |                     | 34                   | 1.72°              |   | —     | —               | —               | No Interference | No Interference |       |
| HTNB 2020-360-3 |                       |                     | 36                   | 1.63°              |   | —     | —               | —               | No Interference | No Interference |       |
| HTNB 2020-400-3 |                       |                     | 40                   | 1.48°              |   | —     | —               | —               | No Interference | No Interference |       |
| HTNB 2020-120-4 |                       |                     | 2°                   | 2°                 |   | 12    | 4.29°           | —               | —               | —               | 12.97 |
| HTNB 2020-160-4 |                       | 16                  |                      |                    | 3.41°   | —     | —               | —               | —               | 17.26           |       |
| HTNB 2020-200-4 | 20                    | 2.83°               |                      |                    | —   | —     | —               | —               | No Interference |                 |       |
| HTNB 2020-300-4 | 30                    | 3.52°               |                      |                    | —   | —     | —               | —               | 32.31           |                 |       |
| HTNB 2020-400-4 | 40                    | 2.78°               | —                    | —                  | —   | —     | No Interference |                 |                 |                 |       |
| HTNB 2020-120-6 | 3°                    | 3°                  | 12                   | 4.48°              | —   | —     | —               | —               |                 |                 |       |
| HTNB 2020-160-6 |                       |                     | 16                   | 3.58°              | —   | —     | —               | —               | —               |                 |       |
| HTNB 2020-200-6 |                       |                     | 20                   | 2.98°              | —   | —     | —               | —               | —               |                 |       |
| HTNB 2020-300-6 |                       |                     | 30                   | 3.71°              | —   | —     | —               | —               | —               |                 |       |
| HTNB 2020-400-6 | 40                    | 2.94°               | —                    | —                  | —   | —     | —               |                 |                 |                 |       |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## 2 Flutes HARDMAX

| Model Number    | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Shape | Suggested Retail Price ¥ |       |      |     |    |        |   |        |
|-----------------|-----------------------|---------------------|----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|-------|--------------------------|-------|------|-----|----|--------|---|--------|
| HTNB 2030-200-1 | R1.5                  | 30°                 | 20                   | 4.5                       | 2.4                  | 2.89                     | 16°                   | 60               | 6                       | B     | 9,740                    |       |      |     |    |        |   |        |
| HTNB 2030-220-1 |                       |                     | 22                   |                           |                      |                          |                       | 60               | 6                       |       | 9,740                    |       |      |     |    |        |   |        |
| HTNB 2030-260-1 |                       |                     | 26                   |                           |                      |                          |                       | 70               | 6                       |       | 10,400                   |       |      |     |    |        |   |        |
| HTNB 2030-300-1 |                       |                     | 30                   |                           |                      |                          |                       | 70               | 6                       |       | 11,880                   |       |      |     |    |        |   |        |
| HTNB 2030-320-1 |                       |                     | 32                   |                           |                      |                          |                       | 70               | 6                       |       | 12,480                   |       |      |     |    |        |   |        |
| HTNB 2030-360-1 |                       |                     | 36                   |                           |                      |                          |                       | 80               | 6                       |       | 13,000                   |       |      |     |    |        |   |        |
| HTNB 2030-400-1 |                       |                     | 40                   |                           |                      |                          |                       | 80               | 6                       |       | 13,200                   |       |      |     |    |        |   |        |
| HTNB 2030-420-1 |                       |                     | 42                   |                           |                      |                          |                       | 90               | 6                       |       | 13,680                   |       |      |     |    |        |   |        |
| HTNB 2030-520-1 |                       |                     | 52                   |                           |                      |                          |                       | 100              | 6                       |       | 15,360                   |       |      |     |    |        |   |        |
| HTNB 2030-200-2 |                       |                     | 1°                   |                           |                      |                          |                       | 20               | 60                      |       | 6                        | 9,740 |      |     |    |        |   |        |
| HTNB 2030-260-2 |                       | 26                  |                      |                           |                      |                          |                       | 70               | 6                       |       | 10,400                   |       |      |     |    |        |   |        |
| HTNB 2030-300-2 |                       | 30                  |                      |                           |                      |                          |                       | 70               | 6                       |       | 11,880                   |       |      |     |    |        |   |        |
| HTNB 2030-320-2 |                       | 32                  |                      |                           |                      |                          |                       | 70               | 6                       |       | 12,480                   |       |      |     |    |        |   |        |
| HTNB 2030-360-2 |                       | 36                  |                      |                           |                      |                          |                       | 80               | 6                       |       | 13,000                   |       |      |     |    |        |   |        |
| HTNB 2030-400-2 |                       | 40                  |                      |                           |                      |                          |                       | 80               | 6                       |       | 13,200                   |       |      |     |    |        |   |        |
| HTNB 2030-420-2 |                       | 42                  |                      |                           |                      |                          |                       | 90               | 6                       |       | 13,680                   |       |      |     |    |        |   |        |
| HTNB 2030-480-2 |                       | 48                  |                      |                           |                      |                          |                       | 100              | 6                       |       | 15,360                   |       |      |     |    |        |   |        |
| HTNB 2030-520-2 |                       | 52                  |                      |                           |                      |                          |                       | 100              | 6                       |       | 15,360                   |       |      |     |    |        |   |        |
| HTNB 2030-620-2 |                       | 62                  |                      |                           |                      |                          |                       | 100              | 6                       |       | 18,230                   |       |      |     |    |        |   |        |
| HTNB 2030-200-3 |                       | 1°30'               | 20                   |                           |                      |                          |                       | 60               | 6                       |       | 9,740                    |       |      |     |    |        |   |        |
| HTNB 2030-260-3 |                       |                     | 26                   |                           |                      |                          |                       | 70               | 6                       |       | 10,400                   |       |      |     |    |        |   |        |
| HTNB 2030-300-3 |                       |                     | 30                   |                           |                      |                          |                       | 70               | 6                       |       | 11,880                   |       |      |     |    |        |   |        |
| HTNB 2030-320-3 |                       |                     | 32                   |                           |                      |                          |                       | 70               | 6                       |       | 12,480                   |       |      |     |    |        |   |        |
| HTNB 2030-360-3 |                       |                     | 36                   |                           |                      |                          |                       | 80               | 6                       |       | 13,000                   |       |      |     |    |        |   |        |
| HTNB 2030-400-3 |                       |                     | 40                   |                           |                      |                          |                       | 80               | 6                       |       | 13,200                   |       |      |     |    |        |   |        |
| HTNB 2030-420-3 |                       |                     | 42                   |                           |                      |                          |                       | 90               | 6                       |       | 13,680                   |       |      |     |    |        |   |        |
| HTNB 2030-580-3 |                       |                     | 58                   |                           |                      |                          |                       | 100              | 6                       |       | 15,360                   |       |      |     |    |        |   |        |
| HTNB 2040-300-1 |                       |                     | R2                   |                           |                      |                          |                       | 30°              | 30                      |       | 6                        | 3.2   | 3.87 | 16° | 80 | 6      | B | 11,590 |
| HTNB 2040-400-1 |                       |                     |                      |                           |                      |                          |                       |                  | 40                      |       |                          |       |      |     | 80 | 6      |   | 15,000 |
| HTNB 2040-620-1 |                       | 62                  |                      |                           |                      |                          |                       |                  | 120                     |       |                          |       |      |     | 6  | 19,200 |   |        |
| HTNB 2040-200-2 | 1°                    | 20                  |                      | 80                        | 6                    | 11,590                   |                       |                  |                         |       |                          |       |      |     |    |        |   |        |
| HTNB 2040-300-2 |                       | 30                  |                      | 80                        | 6                    | 11,590                   |                       |                  |                         |       |                          |       |      |     |    |        |   |        |
| HTNB 2040-360-2 |                       | 36                  |                      | 80                        | 6                    | 13,420                   |                       |                  |                         |       |                          |       |      |     |    |        |   |        |
| HTNB 2040-400-2 |                       | 40                  |                      | 80                        | 6                    | 15,000                   |                       |                  |                         |       |                          |       |      |     |    |        |   |        |
| HTNB 2040-600-2 |                       | 60                  |                      | 120                       | 6                    | 19,200                   |                       |                  |                         |       |                          |       |      |     |    |        |   |        |
| HTNB 2040-410-3 | 1°30'                 | 41                  |                      | 80                        | 6                    | 15,000                   |                       |                  |                         |       |                          |       |      |     |    |        |   |        |
| HTNB 2040-600-3 |                       | 60                  |                      | 120                       | 8                    | 28,000                   |                       |                  |                         |       |                          |       |      |     |    |        |   |        |
| HTNB 2040-800-3 |                       | 80                  |                      | 130                       | 8                    | 30,360                   |                       |                  |                         |       |                          |       |      |     |    |        |   |        |
| HTNB 2040-800-3 |                       | 80                  |                      | 130                       | 8                    | 30,360                   |                       |                  |                         |       |                          |       |      |     |    |        |   |        |
| HTNB 2040-800-3 |                       | 80                  |                      | 130                       | 8                    | 30,360                   |                       |                  |                         |       |                          |       |      |     |    |        |   |        |

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



Unit (mm)

| Model Number    | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Interference Angle | Effective Length by Inclined Angles<br>— : Interference |                 |                 |                 |                 |                 |
|-----------------|-----------------------|---------------------|----------------------|--------------------|---|-----------------|-----------------|-----------------|-----------------|-----------------|
|                 |                       |                     |                      |                    | 30°   | 1°              | 1°30'           | 2°              | 3°              |                 |
| HTNB 2030-200-1 | R1.5                  | 30°                 | 20                   | 3.71°              | —   | 20.59           | 21.23           | 21.92           | 23.46           |                 |
| HTNB 2030-220-1 |                       |                     | 22                   | 3.43°              | —   | 22.65           | 23.36           | 24.13           | 25.83           |                 |
| HTNB 2030-260-1 |                       |                     | 26                   | 2.97°              | —   | 26.78           | 27.63           | 28.54           | No Interference |                 |
| HTNB 2030-300-1 |                       |                     | 30                   | 2.62°              | —   | 30.91           | 31.90           | 32.96           | No Interference |                 |
| HTNB 2030-320-1 |                       |                     | 32                   | 2.48°              | —   | 32.98           | 34.04           | 35.17           | No Interference |                 |
| HTNB 2030-360-1 |                       |                     | 36                   | 2.23°              | —   | 37.11           | 38.30           | 39.58           | No Interference |                 |
| HTNB 2030-400-1 |                       |                     | 40                   | 2.03°              | —   | 41.23           | 42.57           | 44.00           | No Interference |                 |
| HTNB 2030-420-1 |                       |                     | 42                   | 1.94°              | —   | 43.30           | 44.70           | No Interference | No Interference |                 |
| HTNB 2030-520-1 |                       |                     | 52                   | 1.60°              | —   | 53.62           | 55.38           | No Interference | No Interference |                 |
| HTNB 2030-200-2 |                       |                     | 1°                   | 20                 | 3.79°   | —               | —               | 20.66           | 21.33           | 22.83           |
| HTNB 2030-260-2 |                       | 26                  |                      | 3.04°              | —   | —               | 26.87           | 27.75           | 29.72           |                 |
| HTNB 2030-300-2 |                       | 30                  |                      | 2.69°              | —   | —               | 31.00           | 32.03           | No Interference |                 |
| HTNB 2030-320-2 |                       | 32                  |                      | 2.54°              | —   | —               | 33.07           | 34.17           | No Interference |                 |
| HTNB 2030-360-2 |                       | 36                  |                      | 2.29°              | —   | —               | 37.20           | 38.44           | No Interference |                 |
| HTNB 2030-400-2 |                       | 40                  |                      | 2.08°              | —   | —               | 41.33           | 42.72           | No Interference |                 |
| HTNB 2030-420-2 |                       | 42                  |                      | 1.99°              | —   | —               | 43.40           | No Interference | No Interference |                 |
| HTNB 2030-480-2 |                       | 48                  |                      | 1.77°              | —   | —               | 49.60           | No Interference | No Interference |                 |
| HTNB 2030-520-2 |                       | 52                  |                      | 1.64°              | —   | —               | 53.74           | No Interference | No Interference |                 |
| HTNB 2030-620-2 |                       | 62                  |                      | 1.39°              | —   | —               | No Interference | No Interference | No Interference |                 |
| HTNB 2030-200-3 |                       | 1°30'               | 20                   | 3.88°              | —   | —               | —               | 20.75           | 22.20           |                 |
| HTNB 2030-260-3 | 26                    |                     | 3.12°                | —                  | —   | —               | 26.96           | 28.87           |                 |                 |
| HTNB 2030-300-3 | 30                    |                     | 2.76°                | —                  | —   | —               | 31.09           | No Interference |                 |                 |
| HTNB 2030-320-3 | 32                    |                     | 2.61°                | —                  | —   | —               | 33.16           | No Interference |                 |                 |
| HTNB 2030-360-3 | 36                    |                     | 2.35°                | —                  | —   | —               | 37.30           | No Interference |                 |                 |
| HTNB 2030-400-3 | 40                    |                     | 2.14°                | —                  | —   | —               | 41.44           | No Interference |                 |                 |
| HTNB 2030-420-3 | 42                    |                     | 2.05°                | —                  | —   | —               | 43.51           | No Interference |                 |                 |
| HTNB 2030-580-3 | 58                    |                     | 1.53°                | —                  | —   | —               | No Interference | No Interference |                 |                 |
| HTNB 2040-300-1 | R2                    |                     | 30°                  | 30                 | 1.88°   | —               | 30.91           | 31.88           | No Interference | No Interference |
| HTNB 2040-400-1 |                       |                     |                      | 40                 | 1.43°   | —               | 41.23           | No Interference | No Interference | No Interference |
| HTNB 2040-620-1 |                       | 62                  |                      | 0.94°              | —   | No Interference | No Interference | No Interference | No Interference |                 |
| HTNB 2040-200-2 |                       | 1°                  | 20                   | 2.81°              | —   | —               | 20.67           | 21.32           | No Interference |                 |
| HTNB 2040-300-2 |                       |                     | 30                   | 1.93°              | —   | —               | 31.00           | No Interference | No Interference |                 |
| HTNB 2040-360-2 |                       |                     | 36                   | 1.63°              | —   | —               | 37.21           | No Interference | No Interference |                 |
| HTNB 2040-400-2 |                       |                     | 40                   | 1.47°              | —   | —               | No Interference | No Interference | No Interference |                 |
| HTNB 2040-600-2 |                       |                     | 60                   | 1.00°              | —   | —               | No Interference | No Interference | No Interference |                 |
| HTNB 2040-410-3 |                       |                     | 1°30'                | 41                 | 1.48°   | —               | —               | —               | No Interference | No Interference |
| HTNB 2040-600-3 |                       | 60                  |                      | 1.92°              | —   | —               | —               | No Interference | No Interference |                 |
| HTNB 2040-800-3 |                       | 80                  |                      | —                  | —   | —               | —               | No Interference | No Interference |                 |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
RadiusRadius  
Taper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
BallBall  
Taper Neck  
Ball

Taper

Taper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for HTNB

| WORK MATERIAL |                          |                  |                  | COPPER / CARBON STEELS<br>Cu / S45C / S50C |                    |                                 |                             |                | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD (30~45HRC) |                    |                                 |                             |                |
|---------------|--------------------------|------------------|------------------|--|--------------------|---------------------------------|-----------------------------|----------------|--|--------------------|---------------------------------|-----------------------------|----------------|
| Model Number  | Radius of Ball Nose (mm) | Neck Taper Angle | Neck Length (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth |                | Spindle Speed (min <sup>-1</sup> )                           | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth |                |
|               |                          |                  |                  |  |                    |                                 | Roughing (mm)               | Finishing (mm) |  |                    |                                 | Roughing (mm)               | Finishing (mm) |
| 2002          | R0.1                     | 1°30' or below   | 1.5              | 42,000                                     | 640                | 0.008                           | 0.02                        | 0.015          | 29,000   | 430                | 0.006                           | 0.02                        | 0.015          |
|               |                          |                  | 2                | 33,000                                     | 370                | 0.006                           | 0.02                        | 0.011          | 23,500   | 260                | 0.005                           | 0.02                        | 0.011          |
|               |                          |                  | 3                | 27,000                                     | 270                | 0.002                           | 0.02                        | 0.01           | 19,000   | 165                | 0.001                           | 0.02                        | 0.009          |
| 2003          | R0.15                    | 1°30' or below   | 2                | 36,000                                     | 650                | 0.009                           | 0.03                        | 0.018          | 25,200   | 400                | 0.007                           | 0.03                        | 0.016          |
|               |                          |                  | 3                | 33,000                                     | 500                | 0.004                           | 0.03                        | 0.015          | 23,000   | 330                | 0.003                           | 0.03                        | 0.014          |
| 2004          | R0.2                     | 1°30' or below   | 3                | 42,000                                     | 1,300              | 0.018                           | 0.04                        | 0.031          | 29,000   | 800                | 0.014                           | 0.04                        | 0.028          |
|               |                          |                  | 4                | 33,000                                     | 800                | 0.008                           | 0.04                        | 0.024          | 23,000   | 520                | 0.006                           | 0.04                        | 0.023          |
|               |                          |                  | 6                | 27,000                                     | 550                | 0.005                           | 0.04                        | 0.02           | 19,000   | 330                | 0.004                           | 0.04                        | 0.017          |
| 2005          | R0.25                    | 1°30' or below   | 4                | 36,000                                     | 1,330              | 0.02                            | 0.05                        | 0.037          | 28,000   | 870                | 0.016                           | 0.05                        | 0.031          |
|               |                          |                  | 6                | 29,000                                     | 900                | 0.012                           | 0.05                        | 0.031          | 23,000   | 650                | 0.009                           | 0.05                        | 0.028          |
|               |                          |                  | 8                | 23,500                                     | 600                | 0.007                           | 0.05                        | 0.026          | 19,000   | 450                | 0.006                           | 0.05                        | 0.024          |
|               |                          |                  | 10               | 20,000                                     | 480                | 0.004                           | 0.05                        | 0.024          | 18,000   | 380                | 0.003                           | 0.05                        | 0.021          |
| 2006          | R0.3                     | 1°30' or below   | 4                | 44,000                                     | 2,340              | 0.032                           | 0.06                        | 0.053          | 32,500   | 1,500              | 0.025                           | 0.06                        | 0.046          |
|               |                          |                  | 6                | 36,000                                     | 1,500              | 0.018                           | 0.06                        | 0.042          | 29,000   | 1,100              | 0.014                           | 0.06                        | 0.038          |
|               |                          |                  | 8                | 28,500                                     | 1,150              | 0.018                           | 0.06                        | 0.04           | 24,000   | 770                | 0.014                           | 0.06                        | 0.032          |
|               |                          |                  | 10               | 28,500                                     | 950                | 0.014                           | 0.06                        | 0.033          | 24,000   | 720                | 0.011                           | 0.06                        | 0.03           |
|               |                          |                  | 12               | 28,500                                     | 950                | 0.009                           | 0.06                        | 0.033          | 24,000   | 720                | 0.007                           | 0.06                        | 0.03           |
|               |                          |                  | 14               | 26,500                                     | 800                | 0.007                           | 0.06                        | 0.03           | 23,000   | 660                | 0.005                           | 0.06                        | 0.029          |
|               |                          | 2° above         | 16               | 25,000                                     | 700                | 0.005                           | 0.06                        | 0.028          | 22,000   | 600                | 0.004                           | 0.06                        | 0.027          |
|               |                          |                  | 20               | 20,000                                     | 400                | 0.003                           | 0.06                        | 0.02           | 17,000   | 330                | 0.002                           | 0.06                        | 0.019          |
|               |                          |                  | 8                | 28,500                                     | 1,380              | 0.022                           | 0.09                        | 0.048          | 24,000   | 920                | 0.017                           | 0.09                        | 0.038          |
|               |                          |                  | 12               | 28,500                                     | 1,140              | 0.011                           | 0.09                        | 0.04           | 24,000   | 860                | 0.008                           | 0.09                        | 0.036          |
| 2008          | R0.4                     | 1°30' or below   | 20               | 20,000                                     | 480                | 0.004                           | 0.09                        | 0.024          | 17,000   | 400                | 0.002                           | 0.09                        | 0.024          |
|               |                          |                  | 6                | 36,000                                     | 2,000              | 0.023                           | 0.08                        | 0.056          | 24,000   | 1,300              | 0.019                           | 0.08                        | 0.054          |
|               |                          |                  | 8                | 28,500                                     | 1,500              | 0.023                           | 0.08                        | 0.053          | 20,000   | 950                | 0.019                           | 0.08                        | 0.048          |
|               |                          |                  | 12               | 28,500                                     | 1,200              | 0.018                           | 0.08                        | 0.042          | 16,500   | 600                | 0.014                           | 0.08                        | 0.036          |
| 2010          | R0.5                     | 1°30' or below   | 16               | 25,000                                     | 900                | 0.01                            | 0.08                        | 0.036          | 15,000   | 500                | 0.008                           | 0.08                        | 0.033          |
|               |                          |                  | 6                | 35,000                                     | 2,900              | 0.05                            | 0.1                         | 0.083          | 23,000   | 1,850              | 0.04                            | 0.1                         | 0.08           |
|               |                          |                  | 8                | 28,000                                     | 2,200              | 0.05                            | 0.1                         | 0.079          | 19,000   | 1,500              | 0.04                            | 0.1                         | 0.079          |
|               |                          |                  | 10               | 24,000                                     | 1,800              | 0.035                           | 0.1                         | 0.075          | 17,000   | 1,300              | 0.03                            | 0.1                         | 0.076          |
|               |                          |                  | 12               | 19,000                                     | 1,360              | 0.027                           | 0.1                         | 0.072          | 14,000   | 1,000              | 0.022                           | 0.1                         | 0.071          |
|               |                          |                  | 14               | 18,000                                     | 1,200              | 0.025                           | 0.1                         | 0.067          | 13,000   | 900                | 0.02                            | 0.1                         | 0.069          |
|               |                          |                  | 16               | 18,000                                     | 1,150              | 0.025                           | 0.1                         | 0.064          | 13,000   | 850                | 0.02                            | 0.1                         | 0.065          |
|               |                          |                  | 18               | 17,500                                     | 1,120              | 0.018                           | 0.1                         | 0.064          | 12,500   | 800                | 0.013                           | 0.1                         | 0.064          |
|               |                          | 2° or above      | 20               | 17,000                                     | 1,080              | 0.016                           | 0.1                         | 0.064          | 12,000   | 780                | 0.013                           | 0.1                         | 0.064          |
|               |                          |                  | 22               | 17,000                                     | 1,080              | 0.016                           | 0.1                         | 0.064          | 12,000   | 780                | 0.013                           | 0.1                         | 0.064          |
|               |                          |                  | 26               | 16,000                                     | 1,000              | 0.015                           | 0.1                         | 0.063          | 11,000   | 700                | 0.012                           | 0.1                         | 0.064          |
|               |                          |                  | 29.8             | 13,400                                     | 840                | 0.012                           | 0.1                         | 0.063          | 10,000   | 620                | 0.01                            | 0.1                         | 0.062          |
|               |                          |                  | 30               | 13,400                                     | 840                | 0.012                           | 0.1                         | 0.063          | 10,000   | 620                | 0.01                            | 0.1                         | 0.062          |
|               |                          |                  | 32               | 12,000                                     | 750                | 0.011                           | 0.1                         | 0.063          | 9,000  | 550                | 0.009                           | 0.1                         | 0.061          |
|               |                          |                  | 36               | 10,000                                     | 620                | 0.009                           | 0.1                         | 0.062          | 7,000  | 420                | 0.007                           | 0.1                         | 0.06           |
|               |                          |                  | 12               | 19,000                                     | 1,632              | 0.032                           | 0.15                        | 0.086          | 14,000   | 1,200              | 0.026                           | 0.15                        | 0.086          |
| 16            | 18,000                   | 1,380            | 0.03             | 0.15                                       | 0.077              | 13,000                          | 1,020                       | 0.024          | 0.15   | 0.078              |                                 |                             |                |
| 20            | 17,000                   | 1,300            | 0.019            | 0.15                                       | 0.076              | 12,000                          | 920                         | 0.016          | 0.15   | 0.077              |                                 |                             |                |
| 29.8          | 13,400                   | 1,000            | 0.014            | 0.15                                       | 0.075              | 10,000                          | 740                         | 0.012          | 0.15   | 0.074              |                                 |                             |                |
| 30            | 13,400                   | 1,000            | 0.014            | 0.15                                       | 0.075              | 10,000                          | 740                         | 0.012          | 0.15   | 0.074              |                                 |                             |                |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for HTNB

| WORK MATERIAL |                          |                  |                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                           |                       |                | HARDENED STEELS<br>SKD / SKS<br>(55~65HRC) |                    |                           |                       |                |
|---------------|--------------------------|------------------|------------------|--|--------------------|---------------------------|-----------------------|----------------|--|--------------------|---------------------------|-----------------------|----------------|
| Model Number  | Radius of Ball Nose (mm) | Neck Taper Angle | Neck Length (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth |                | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth |                |
|               |                          |                  |                  |  |                    |                           | Roughing (mm)         | Finishing (mm) |  |                    |                           | Roughing (mm)         | Finishing (mm) |
| 2002          | R0.1                     | 1°30' or below   | 1.5              | 28,000                                     | 330                | 0.006                     | 0.016                 | 0.012          | 28,000                                     | 260                | 0.005                     | 0.012                 | 0.009          |
|               |                          |                  | 2                | 22,000                                     | 210                | 0.004                     | 0.016                 | 0.01           | 22,000                                     | 190                | 0.004                     | 0.012                 | 0.009          |
|               |                          |                  | 3                | 17,500                                     | 150                | 0.001                     | 0.016                 | 0.009          | 17,500                                     | 130                | 0.001                     | 0.012                 | 0.007          |
| 2003          | R0.15                    | 1°30' or below   | 2                | 23,500                                     | 350                | 0.006                     | 0.024                 | 0.015          | 23,500                                     | 300                | 0.005                     | 0.018                 | 0.013          |
|               |                          |                  | 3                | 21,500                                     | 250                | 0.003                     | 0.024                 | 0.012          | 21,500                                     | 200                | 0.002                     | 0.018                 | 0.009          |
| 2004          | R0.2                     | 1°30' or below   | 3                | 27,000                                     | 670                | 0.012                     | 0.032                 | 0.025          | 27,000                                     | 500                | 0.01                      | 0.024                 | 0.019          |
|               |                          |                  | 4                | 22,000                                     | 430                | 0.006                     | 0.032                 | 0.02           | 22,000                                     | 380                | 0.005                     | 0.024                 | 0.017          |
|               |                          |                  | 6                | 18,000                                     | 300                | 0.004                     | 0.032                 | 0.017          | 18,000                                     | 260                | 0.003                     | 0.024                 | 0.014          |
| 2005          | R0.25                    | 1°30' or below   | 4                | 27,500                                     | 650                | 0.014                     | 0.04                  | 0.024          | 27,500                                     | 625                | 0.011                     | 0.03                  | 0.023          |
|               |                          |                  | 6                | 22,000                                     | 530                | 0.008                     | 0.04                  | 0.024          | 22,000                                     | 500                | 0.007                     | 0.03                  | 0.023          |
|               |                          |                  | 8                | 17,000                                     | 380                | 0.005                     | 0.04                  | 0.022          | 17,000                                     | 350                | 0.004                     | 0.03                  | 0.021          |
|               |                          |                  | 10               | 16,000                                     | 330                | 0.002                     | 0.04                  | 0.021          | 16,000                                     | 300                | 0.002                     | 0.03                  | 0.019          |
| 2006          | R0.3                     | 1°30' or below   | 4                | 25,500                                     | 850                | 0.022                     | 0.048                 | 0.033          | 25,500                                     | 713                | 0.018                     | 0.036                 | 0.028          |
|               |                          |                  | 6                | 21,000                                     | 700                | 0.012                     | 0.048                 | 0.033          | 21,000                                     | 550                | 0.01                      | 0.036                 | 0.026          |
|               |                          |                  | 8                | 17,000                                     | 510                | 0.012                     | 0.048                 | 0.03           | 17,000                                     | 425                | 0.01                      | 0.036                 | 0.025          |
|               |                          |                  | 10               | 17,000                                     | 470                | 0.009                     | 0.048                 | 0.028          | 16,000                                     | 390                | 0.008                     | 0.036                 | 0.024          |
|               |                          |                  | 12               | 16,000                                     | 400                | 0.006                     | 0.048                 | 0.025          | 15,000                                     | 350                | 0.005                     | 0.036                 | 0.023          |
|               |                          |                  | 14               | 15,500                                     | 370                | 0.004                     | 0.048                 | 0.024          | 14,500                                     | 320                | 0.004                     | 0.036                 | 0.022          |
|               |                          |                  | 16               | 15,000                                     | 350                | 0.003                     | 0.048                 | 0.023          | 14,500                                     | 300                | 0.003                     | 0.036                 | 0.021          |
|               |                          |                  | 20               | 12,000                                     | 200                | 0.001                     | 0.048                 | 0.017          | 11,000                                     | 180                | 0.001                     | 0.036                 | 0.016          |
|               |                          | 2° above         | 8                | 17,000                                     | 610                | 0.014                     | 0.06                  | 0.036          | 17,000                                     | 510                | 0.012                     | 0.048                 | 0.03           |
|               |                          |                  | 12               | 16,000                                     | 480                | 0.007                     | 0.06                  | 0.03           | 15,000                                     | 420                | 0.006                     | 0.048                 | 0.028          |
| 20            | 12,000                   | 240              | 0.001            | 0.06                                       | 0.02               | 11,000                    | 210                   | 0.001          | 0.048                                      | 0.019              |                           |                       |                |
| 2008          | R0.4                     | 1°30' or below   | 6                | 21,000                                     | 900                | 0.016                     | 0.064                 | 0.043          | 21,000                                     | 800                | 0.013                     | 0.048                 | 0.038          |
|               |                          |                  | 8                | 17,000                                     | 680                | 0.016                     | 0.064                 | 0.04           | 17,000                                     | 600                | 0.013                     | 0.048                 | 0.035          |
|               |                          |                  | 12               | 14,000                                     | 480                | 0.012                     | 0.064                 | 0.034          | 14,000                                     | 420                | 0.01                      | 0.048                 | 0.03           |
|               |                          |                  | 16               | 13,000                                     | 420                | 0.006                     | 0.064                 | 0.032          | 12,500                                     | 350                | 0.006                     | 0.048                 | 0.028          |
| 2010          | R0.5                     | 1°30' or below   | 6                | 23,000                                     | 1,500              | 0.034                     | 0.08                  | 0.065          | 22,000                                     | 1,200              | 0.028                     | 0.06                  | 0.055          |
|               |                          |                  | 8                | 19,000                                     | 1,130              | 0.034                     | 0.08                  | 0.059          | 18,000                                     | 920                | 0.028                     | 0.06                  | 0.051          |
|               |                          |                  | 10               | 16,000                                     | 950                | 0.027                     | 0.08                  | 0.059          | 15,500                                     | 770                | 0.022                     | 0.06                  | 0.05           |
|               |                          |                  | 12               | 12,600                                     | 760                | 0.019                     | 0.08                  | 0.06           | 12,600                                     | 615                | 0.015                     | 0.06                  | 0.049          |
|               |                          |                  | 14               | 12,000                                     | 700                | 0.017                     | 0.08                  | 0.058          | 12,000                                     | 540                | 0.014                     | 0.06                  | 0.045          |
|               |                          |                  | 16               | 12,000                                     | 700                | 0.017                     | 0.08                  | 0.058          | 12,000                                     | 540                | 0.014                     | 0.06                  | 0.045          |
|               |                          |                  | 18               | 11,000                                     | 640                | 0.011                     | 0.08                  | 0.058          | 11,000                                     | 490                | 0.01                      | 0.06                  | 0.045          |
|               |                          |                  | 20               | 11,000                                     | 640                | 0.011                     | 0.08                  | 0.058          | 11,000                                     | 490                | 0.009                     | 0.06                  | 0.045          |
|               |                          |                  | 22               | 11,000                                     | 640                | 0.011                     | 0.08                  | 0.058          | 11,000                                     | 490                | 0.009                     | 0.06                  | 0.045          |
|               |                          |                  | 26               | 10,000                                     | 570                | 0.01                      | 0.08                  | 0.057          | 10,000                                     | 460                | 0.009                     | 0.06                  | 0.046          |
|               |                          |                  | 29.8             | 9,500                                      | 530                | 0.009                     | 0.08                  | 0.055          | 9,500                                      | 410                | 0.008                     | 0.06                  | 0.043          |
|               |                          |                  | 30               | 9,500                                      | 530                | 0.009                     | 0.08                  | 0.055          | 9,500                                      | 410                | 0.008                     | 0.06                  | 0.043          |
|               |                          |                  | 32               | 9,000                                      | 490                | 0.008                     | 0.08                  | 0.054          | 9,000                                      | 380                | 0.007                     | 0.06                  | 0.042          |
|               |                          |                  | 36               | 7,000                                      | 380                | 0.006                     | 0.08                  | 0.054          | 7,000                                      | 280                | 0.005                     | 0.06                  | 0.04           |
|               |                          | 2° or above      | 12               | 12,600                                     | 910                | 0.023                     | 0.1                   | 0.072          | 12,600                                     | 740                | 0.018                     | 0.08                  | 0.059          |
|               |                          |                  | 16               | 12,000                                     | 840                | 0.02                      | 0.1                   | 0.07           | 12,000                                     | 650                | 0.017                     | 0.08                  | 0.054          |
|               |                          |                  | 20               | 11,000                                     | 770                | 0.013                     | 0.1                   | 0.07           | 11,000                                     | 590                | 0.011                     | 0.08                  | 0.054          |
| 29.8          | 9,500                    |                  | 640              | 0.011                                      | 0.1                | 0.067                     | 9,500                 | 490            | 0.01                                       | 0.08               | 0.052                     |                       |                |
| 30            | 9,500                    | 640              | 0.011            | 0.1  | 0.067              | 9,500                     | 490                   | 0.01           | 0.08                                       | 0.052              |                           |                       |                |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
Ball  
Taper Neck  
BallTaper  
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for HTNB

| WORK MATERIAL |                          |                  |                  | COPPER / CARBON STEELS<br>Cu / S45C / S50C |                    |                                 |                             |                | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD (30~45HRC) |                    |                                 |                             |                |       |     |       |
|---------------|--------------------------|------------------|------------------|--|--------------------|---------------------------------|-----------------------------|----------------|--|--------------------|---------------------------------|-----------------------------|----------------|-------|-----|-------|
| Model Number  | Radius of Ball Nose (mm) | Neck Taper Angle | Neck Length (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth |                | Spindle Speed (min <sup>-1</sup> )                           | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth |                |       |     |       |
|               |                          |                  |                  |  |                    |                                 | Roughing (mm)               | Finishing (mm) |  |                    |                                 | Roughing (mm)               | Finishing (mm) |       |     |       |
| 2015          | R0.75                    | 1°30' or below   | 10               | 20,000                                     | 2,300              | 0.065                           | 0.15                        | 0.115          | 13,000   | 1,600              | 0.05                            | 0.15                        | 0.123          |       |     |       |
|               |                          |                  | 12               | 18,000                                     | 2,000              | 0.055                           | 0.15                        | 0.111          | 13,000   | 1,500              | 0.045                           | 0.15                        | 0.115          |       |     |       |
|               |                          |                  | 16               | 16,000                                     | 1,600              | 0.05                            | 0.15                        | 0.1            | 12,000   | 1,200              | 0.03                            | 0.15                        | 0.1            |       |     |       |
|               |                          |                  | 20               | 14,000                                     | 1,400              | 0.035                           | 0.15                        | 0.1            | 10,000   | 950                | 0.025                           | 0.15                        | 0.095          |       |     |       |
|               |                          |                  | 22               | 14,000                                     | 1,400              | 0.035                           | 0.15                        | 0.1            | 10,000   | 950                | 0.025                           | 0.15                        | 0.095          |       |     |       |
|               |                          |                  | 26               | 12,000                                     | 1,200              | 0.025                           | 0.15                        | 0.1            | 10,000   | 900                | 0.02                            | 0.15                        | 0.09           |       |     |       |
|               |                          |                  | 30               | 10,000                                     | 950                | 0.02                            | 0.15                        | 0.095          | 8,000  | 700                | 0.015                           | 0.15                        | 0.088          |       |     |       |
|               |                          | 36               | 10,000           | 950  | 0.02               | 0.15                            | 0.095                       | 7,000          | 600  | 0.015              | 0.15                            | 0.086                       |                |       |     |       |
|               |                          | 2° or above      | 12               | 18,000                                     | 2,400              | 0.066                           | 0.225                       | 0.133          | 13,000   | 1,800              | 0.054                           | 0.225                       | 0.138          |       |     |       |
|               |                          |                  | 16               | 16,000                                     | 1,920              | 0.06                            | 0.225                       | 0.12           | 12,000   | 1,440              | 0.036                           | 0.225                       | 0.12           |       |     |       |
|               |                          |                  | 20               | 14,000                                     | 1,680              | 0.042                           | 0.225                       | 0.12           | 10,000   | 1,140              | 0.03                            | 0.225                       | 0.114          |       |     |       |
|               |                          |                  | 30               | 10,000                                     | 1,140              | 0.024                           | 0.225                       | 0.114          | 8,000  | 840                | 0.018                           | 0.225                       | 0.105          |       |     |       |
|               |                          |                  | 2020             | R1   | 1°30' or below     | 10                              | 19,000                      | 3,300          | 0.11   | 0.2                | 0.174                           | 12,000                      | 2,100          | 0.1   | 0.2 | 0.175 |
|               |                          |                  |                  |  |                    | 12                              | 17,000                      | 2,900          | 0.09   | 0.2                | 0.171                           | 12,000                      | 2,000          | 0.095 | 0.2 | 0.167 |
| 16            | 15,000                   |                  |                  |  |                    | 2,350                           | 0.081                       | 0.2            | 0.157  | 11,000             | 1,700                           | 0.065                       | 0.2            | 0.155 |     |       |
| 20            | 11,000                   | 1,600            |                  |  |                    | 0.068                           | 0.2                         | 0.145          | 8,400  | 1,100              | 0.055                           | 0.2                         | 0.131          |       |     |       |
| 22            | 11,000                   | 1,600            |                  |  |                    | 0.063                           | 0.2                         | 0.145          | 8,400  | 1,050              | 0.05                            | 0.2                         | 0.125          |       |     |       |
| 24            | 11,000                   | 1,500            |                  |  |                    | 0.063                           | 0.2                         | 0.136          | 8,400  | 1,050              | 0.05                            | 0.2                         | 0.125          |       |     |       |
| 26            | 10,000                   | 1,350            |                  |  |                    | 0.063                           | 0.2                         | 0.135          | 7,350  | 900                | 0.05                            | 0.2                         | 0.122          |       |     |       |
| 28            | 10,000                   | 1,350            |                  |  |                    | 0.05                            | 0.2                         | 0.135          | 7,350  | 870                | 0.038                           | 0.2                         | 0.118          |       |     |       |
| 30            | 10,000                   | 1,350            |                  |  |                    | 0.05                            | 0.2                         | 0.135          | 7,350  | 870                | 0.038                           | 0.2                         | 0.118          |       |     |       |
| 32            | 10,000                   | 1,350            |                  |  |                    | 0.041                           | 0.2                         | 0.135          | 7,350  | 850                | 0.032                           | 0.2                         | 0.116          |       |     |       |
| 34            | 10,000                   | 1,350            |                  |  |                    | 0.041                           | 0.2                         | 0.135          | 7,000  | 800                | 0.032                           | 0.2                         | 0.114          |       |     |       |
| 36            | 10,000                   | 1,350            |                  |  |                    | 0.041                           | 0.2                         | 0.135          | 7,000  | 800                | 0.032                           | 0.2                         | 0.114          |       |     |       |
| 40            | 10,000                   | 1,350            |                  |  |                    | 0.041                           | 0.2                         | 0.135          | 7,000  | 800                | 0.032                           | 0.3                         | 0.114          |       |     |       |
| 2° or above   | 12                       | 17,000           |                  |  |                    | 3,480                           | 0.108                       | 0.3            | 0.205  | 12,000             | 2,400                           | 0.114                       | 0.3            | 0.2   |     |       |
|               | 16                       | 15,000           | 2,820            | 0.097                                      | 0.3                | 0.188                           | 11,000                      | 2,040          | 0.078  | 0.3                | 0.185                           |                             |                |       |     |       |
|               | 20                       | 11,000           | 1,920            | 0.082                                      | 0.3                | 0.175                           | 8,400                       | 1,320          | 0.066  | 0.3                | 0.157                           |                             |                |       |     |       |
|               | 30                       | 10,000           | 1,620            | 0.06                                       | 0.3                | 0.162                           | 7,350                       | 1,040          | 0.046  | 0.3                | 0.141                           |                             |                |       |     |       |
|               | 40                       | 10,000           | 1,620            | 0.049                                      | 0.3                | 0.135                           | 7,000                       | 960            | 0.038  | 0.3                | 0.135                           |                             |                |       |     |       |
|               | 2030                     | R1.5             | 1°30' or below   | 20   | 11,000             | 2,350                           | 0.095                       | 0.3            | 0.214  | 8,400              | 1,500                           | 0.075                       | 0.3            | 0.179 |     |       |
|               |                          |                  |                  | 22   | 11,000             | 2,350                           | 0.09                        | 0.3            | 0.214  | 8,400              | 1,500                           | 0.071                       | 0.3            | 0.179 |     |       |
| 26            |                          |                  |                  | 10,000                                     | 2,050              | 0.085                           | 0.3                         | 0.205          | 7,600  | 1,300              | 0.068                           | 0.3                         | 0.171          |       |     |       |
| 30            |                          |                  |                  | 10,000                                     | 2,000              | 0.081                           | 0.3                         | 0.2            | 7,500  | 1,250              | 0.065                           | 0.3                         | 0.167          |       |     |       |
| 32            |                          |                  |                  | 10,000                                     | 1,900              | 0.081                           | 0.3                         | 0.19           | 7,500  | 1,200              | 0.065                           | 0.3                         | 0.16           |       |     |       |
| 36            |                          |                  |                  | 9,000                                      | 1,700              | 0.073                           | 0.3                         | 0.189          | 6,000  | 950                | 0.058                           | 0.3                         | 0.158          |       |     |       |
| 40            |                          |                  |                  | 8,500                                      | 1,600              | 0.065                           | 0.3                         | 0.188          | 6,000  | 950                | 0.053                           | 0.3                         | 0.158          |       |     |       |
| 42            |                          |                  |                  | 8,500                                      | 1,600              | 0.063                           | 0.3                         | 0.188          | 6,000  | 950                | 0.05                            | 0.3                         | 0.158          |       |     |       |
| 48            |                          |                  |                  | 8,500                                      | 1,570              | 0.052                           | 0.3                         | 0.185          | 6,000  | 920                | 0.042                           | 0.3                         | 0.153          |       |     |       |
| 52            |                          |                  |                  | 8,500                                      | 1,550              | 0.045                           | 0.3                         | 0.182          | 6,000  | 900                | 0.036                           | 0.3                         | 0.15           |       |     |       |
| 62            |                          |                  |                  | 5,600                                      | 930                | 0.035                           | 0.3                         | 0.166          | 5,000  | 700                | 0.025                           | 0.3                         | 0.14           |       |     |       |

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for HTNB

| WORK MATERIAL |                          |                  |                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                           |                       |                | HARDENED STEELS<br>SKD / SKS<br>(55~65HRC) |                    |                           |                       |                |       |      |       |
|---------------|--------------------------|------------------|------------------|--|--------------------|---------------------------|-----------------------|----------------|--|--------------------|---------------------------|-----------------------|----------------|-------|------|-------|
| Model Number  | Radius of Ball Nose (mm) | Neck Taper Angle | Neck Length (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth |                | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth |                |       |      |       |
|               |                          |                  |                  |  |                    |                           | Roughing (mm)         | Finishing (mm) |  |                    |                           | Roughing (mm)         | Finishing (mm) |       |      |       |
| 2015          | R0.75                    | 1°30' or below   | 10               | 13,000                                     | 1,200              | 0.04                      | 0.12                  | 0.092          | 13,000                                     | 950                | 0.035                     | 0.09                  | 0.073          |       |      |       |
|               |                          |                  | 12               | 11,000                                     | 950                | 0.035                     | 0.12                  | 0.086          | 11,000                                     | 750                | 0.03                      | 0.09                  | 0.068          |       |      |       |
|               |                          |                  | 16               | 11,000                                     | 900                | 0.03                      | 0.12                  | 0.082          | 11,000                                     | 750                | 0.025                     | 0.09                  | 0.068          |       |      |       |
|               |                          |                  | 20               | 10,000                                     | 800                | 0.02                      | 0.12                  | 0.08           | 10,000                                     | 650                | 0.018                     | 0.09                  | 0.065          |       |      |       |
|               |                          |                  | 22               | 10,000                                     | 800                | 0.02                      | 0.12                  | 0.08           | 10,000                                     | 650                | 0.018                     | 0.09                  | 0.065          |       |      |       |
|               |                          |                  | 26               | 9,000                                      | 700                | 0.017                     | 0.12                  | 0.078          | 9,000                                      | 600                | 0.015                     | 0.09                  | 0.067          |       |      |       |
|               |                          |                  | 30               | 8,000                                      | 600                | 0.013                     | 0.12                  | 0.075          | 8,000                                      | 500                | 0.013                     | 0.09                  | 0.063          |       |      |       |
|               |                          |                  | 36               | 7,000                                      | 500                | 0.013                     | 0.12                  | 0.071          | 7,000                                      | 400                | 0.013                     | 0.09                  | 0.057          |       |      |       |
|               |                          | 2° or above      | 12               | 11,000                                     | 1,140              | 0.042                     | 0.15                  | 0.104          | 11,000                                     | 900                | 0.036                     | 0.12                  | 0.082          |       |      |       |
|               |                          |                  | 16               | 11,000                                     | 1,080              | 0.036                     | 0.15                  | 0.098          | 11,000                                     | 900                | 0.03                      | 0.12                  | 0.082          |       |      |       |
|               |                          |                  | 20               | 10,000                                     | 960                | 0.024                     | 0.15                  | 0.096          | 10,000                                     | 780                | 0.022                     | 0.12                  | 0.078          |       |      |       |
|               |                          |                  | 30               | 8,000                                      | 720                | 0.016                     | 0.15                  | 0.09           | 8,000                                      | 600                | 0.016                     | 0.12                  | 0.075          |       |      |       |
|               |                          |                  | 2020             | R1   | 1°30' or below     | 10                        | 12,000                | 1,800          | 0.074                                      | 0.16               | 0.15                      | 12,000                | 1,350          | 0.064 | 0.12 | 0.113 |
|               |                          |                  |                  |  |                    | 12                        | 10,500                | 1,430          | 0.065                                      | 0.16               | 0.136                     | 10,500                | 1,070          | 0.055 | 0.12 | 0.102 |
| 16            | 10,500                   | 1,360            |                  |  |                    | 0.056                     | 0.16                  | 0.13           | 10,500                                     | 1,070              | 0.046                     | 0.12                  | 0.102          |       |      |       |
| 20            | 9,450                    | 1,150            |                  |  |                    | 0.048                     | 0.16                  | 0.122          | 9,450                                      | 920                | 0.038                     | 0.12                  | 0.097          |       |      |       |
| 22            | 9,450                    | 1,150            |                  |  |                    | 0.043                     | 0.16                  | 0.122          | 9,450                                      | 920                | 0.036                     | 0.12                  | 0.097          |       |      |       |
| 24            | 8,400                    | 1,020            |                  |  |                    | 0.043                     | 0.16                  | 0.121          | 8,400                                      | 800                | 0.036                     | 0.12                  | 0.095          |       |      |       |
| 26            | 8,400                    | 1,020            |                  |  |                    | 0.043                     | 0.16                  | 0.121          | 8,400                                      | 800                | 0.036                     | 0.12                  | 0.095          |       |      |       |
| 28            | 7,350                    | 850              |                  |  |                    | 0.033                     | 0.16                  | 0.116          | 7,350                                      | 690                | 0.028                     | 0.12                  | 0.094          |       |      |       |
| 30            | 7,350                    | 850              |                  |  |                    | 0.033                     | 0.16                  | 0.116          | 7,350                                      | 690                | 0.028                     | 0.12                  | 0.094          |       |      |       |
| 32            | 7,350                    | 850              |                  |  |                    | 0.028                     | 0.16                  | 0.116          | 7,350                                      | 690                | 0.023                     | 0.12                  | 0.094          |       |      |       |
| 34            | 6,500                    | 745              |                  |  |                    | 0.028                     | 0.16                  | 0.115          | 6,500                                      | 610                | 0.023                     | 0.12                  | 0.094          |       |      |       |
| 36            | 6,500                    | 745              |                  |  |                    | 0.028                     | 0.16                  | 0.115          | 6,500                                      | 610                | 0.023                     | 0.12                  | 0.094          |       |      |       |
| 40            | 6,500                    | 745              |                  |  |                    | 0.028                     | 0.16                  | 0.115          | 6,500                                      | 610                | 0.023                     | 0.12                  | 0.094          |       |      |       |
| 2° or above   | 12                       | 10,500           |                  |  |                    | 1,720                     | 0.078                 | 0.2            | 0.164                                      | 10,500             | 1,280                     | 0.066                 | 0.16           | 0.122 |      |       |
|               | 16                       | 10,500           | 1,630            | 0.067                                      | 0.2                | 0.155                     | 10,500                | 1,280          | 0.055                                      | 0.16               | 0.122                     |                       |                |       |      |       |
|               | 20                       | 9,450            | 1,380            | 0.058                                      | 0.2                | 0.146                     | 9,450                 | 1,100          | 0.046                                      | 0.16               | 0.117                     |                       |                |       |      |       |
|               | 30                       | 7,350            | 1,020            | 0.04                                       | 0.2                | 0.139                     | 7,350                 | 830            | 0.034                                      | 0.16               | 0.113                     |                       |                |       |      |       |
|               | 40                       | 6,500            | 890              | 0.034                                      | 0.2                | 0.135                     | 6,500                 | 730            | 0.028                                      | 0.16               | 0.113                     |                       |                |       |      |       |
|               | 2030                     | R1.5             | 1°30' or below   | 20   | 8,000              | 1,400                     | 0.065                 | 0.24           | 0.175                                      | 8,000              | 1,200                     | 0.053                 | 0.18           | 0.15  |      |       |
| 22            |                          |                  |                  | 8,000                                      | 1,400              | 0.062                     | 0.24                  | 0.175          | 8,000                                      | 1,200              | 0.05                      | 0.18                  | 0.15           |       |      |       |
| 26            |                          |                  |                  | 7,500                                      | 1,200              | 0.06                      | 0.24                  | 0.16           | 7,500                                      | 1,050              | 0.048                     | 0.18                  | 0.14           |       |      |       |
| 30            |                          |                  |                  | 7,000                                      | 1,100              | 0.057                     | 0.24                  | 0.157          | 7,000                                      | 980                | 0.047                     | 0.18                  | 0.14           |       |      |       |
| 32            |                          |                  |                  | 7,000                                      | 1,100              | 0.056                     | 0.24                  | 0.157          | 7,000                                      | 950                | 0.046                     | 0.18                  | 0.136          |       |      |       |
| 36            |                          |                  |                  | 6,000                                      | 950                | 0.05                      | 0.24                  | 0.158          | 6,000                                      | 800                | 0.042                     | 0.18                  | 0.133          |       |      |       |
| 40            |                          |                  |                  | 5,500                                      | 850                | 0.045                     | 0.24                  | 0.155          | 5,500                                      | 750                | 0.038                     | 0.18                  | 0.136          |       |      |       |
| 42            |                          |                  |                  | 5,500                                      | 850                | 0.043                     | 0.24                  | 0.155          | 5,500                                      | 750                | 0.036                     | 0.18                  | 0.136          |       |      |       |
| 48            |                          |                  |                  | 5,500                                      | 820                | 0.035                     | 0.24                  | 0.149          | 5,500                                      | 720                | 0.03                      | 0.18                  | 0.131          |       |      |       |
| 52            |                          |                  |                  | 5,500                                      | 800                | 0.031                     | 0.24                  | 0.145          | 5,500                                      | 700                | 0.026                     | 0.18                  | 0.127          |       |      |       |
| 62            |                          |                  |                  | 4,700                                      | 600                | 0.023                     | 0.24                  | 0.128          | 4,700                                      | 530                | 0.021                     | 0.18                  | 0.113          |       |      |       |

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallBall  
Long Neck  
BallTaper Neck  
Ball

Taper

Barrel

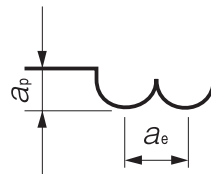
Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for HTNB

| WORK MATERIAL     |                          |                  |                  | COPPER / CARBON STEELS<br>Cu / S45C / S50C   |                    |                                 |                             |                | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC)  |                    |                                 |                             |                |
|-------------------|--------------------------|------------------|------------------|--|--------------------|---------------------------------|-----------------------------|----------------|--|--------------------|---------------------------------|-----------------------------|----------------|
| Model Number      | Radius of Ball Nose (mm) | Neck Taper Angle | Neck Length (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth |                | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth |                |
|                   |                          |                  |                  |  |                    |                                 | Roughing (mm)               | Finishing (mm) |  |                    |                                 | Roughing (mm)               | Finishing (mm) |
| 2040              | R2                       | 1°30' or below   | 20               | 8,400  | 1,900              | 0.125                           | 0.4                         | 0.226          | 5,400  | 1,030              | 0.096                           | 0.4                         | 0.191          |
|                   |                          |                  | 30               | 7,600  | 1,600              | 0.1                             | 0.4                         | 0.211          | 4,800  | 850                | 0.083                           | 0.4                         | 0.177          |
|                   |                          |                  | 36               | 6,900  | 1,400              | 0.094                           | 0.4                         | 0.203          | 3,900  | 650                | 0.074                           | 0.4                         | 0.167          |
|                   |                          |                  | 40               | 6,500  | 1,300              | 0.086                           | 0.4                         | 0.2            | 3,900  | 650                | 0.068                           | 0.4                         | 0.167          |
|                   |                          |                  | 41               | 6,500  | 1,300              | 0.086                           | 0.4                         | 0.2            | 3,900  | 650                | 0.068                           | 0.4                         | 0.167          |
|                   |                          |                  | 60               | 4,300  | 780                | 0.063                           | 0.4                         | 0.181          | 3,300  | 500                | 0.05                            | 0.4                         | 0.152          |
|                   |                          |                  | 62               | 4,300  | 750                | 0.063                           | 0.4                         | 0.174          | 3,300  | 480                | 0.05                            | 0.4                         | 0.145          |
|                   |                          |                  | 80               | 4,300  | 750                | 0.063                           | 0.4                         | 0.174          | 3,300  | 480                | 0.05                            | 0.4                         | 0.145          |
| Radial Depth (mm) |                          |                  | Roughing         | Neck Taper Angle 1°30' or below a <sub>e</sub> ≤ 0.1D.<br>Neck Taper Angle 2° or above a <sub>e</sub> ≤ 0.15D. |                    |                                 |                             |                | Neck Taper Angle 1°30' or below a <sub>e</sub> ≤ 0.1D.<br>Neck Taper Angle 2° or above a <sub>e</sub> ≤ 0.15D. |                    |                                 |                             |                |
|                   |                          |                  | Finishing        | $a_e \leq Vf / n$  |                    |                                 |                             |                |  |                    |                                 |                             |                |



D : Outside Diameter (mm)  
n : Spindle Speed  
Vf : Feed Rate

- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

## Milling Conditions for HTNB

| WORK MATERIAL     |                          |                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |  |                    |                           |                       |   | HARDENED STEELS<br>SKD / SKS<br>(55~65HRC) |                    |                           |                       |                |
|-------------------|--------------------------|------------------|--|--|--------------------|---------------------------|-----------------------|---|--|--------------------|---------------------------|-----------------------|----------------|
| Model Number      | Radius of Ball Nose (mm) | Neck Taper Angle | Neck Length (mm)                           | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth |   | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | $a_p$<br>Axial Depth (mm) | $a_e$<br>Radial Depth |                |
|                   |                          |                  |  |  |                    |                           | Roughing (mm)         | Finishing (mm)  |  |                    |                           | Roughing (mm)         | Finishing (mm) |
| 2040              | R2                       | 1°30' or below   | 20   | 5,200  | 980                | 0.085                     | 0.32                  | 0.188   | 5,200                                      | 840                | 0.066                     | 0.24                  | 0.162          |
|                   |                          |                  | 30   | 4,500  | 770                | 0.074                     | 0.32                  | 0.171   | 4,500                                      | 690                | 0.059                     | 0.24                  | 0.153          |
|                   |                          |                  | 36   | 3,900  | 670                | 0.065                     | 0.32                  | 0.172   | 3,900                                      | 560                | 0.052                     | 0.24                  | 0.144          |
|                   |                          |                  | 40   | 3,600  | 600                | 0.059                     | 0.32                  | 0.167   | 3,600                                      | 530                | 0.048                     | 0.24                  | 0.147          |
|                   |                          |                  | 41   | 3,600  | 600                | 0.059                     | 0.32                  | 0.167   | 3,600                                      | 530                | 0.048                     | 0.24                  | 0.147          |
|                   |                          |                  | 60   | 3,100  | 450                | 0.043                     | 0.32                  | 0.145   | 3,100                                      | 400                | 0.036                     | 0.24                  | 0.129          |
|                   |                          |                  | 62   | 3,100  | 420                | 0.043                     | 0.32                  | 0.135   | 3,100                                      | 380                | 0.036                     | 0.24                  | 0.123          |
|                   |                          |                  | 80   | 2,900  | 340                | 0.035                     | 0.32                  | 0.117   | 2,500                                      | 200                | 0.02                      | 0.24                  | 0.08           |
| Radial Depth (mm) |                          |                  | Roughing                                   | Neck Taper Angle 1°30' or below $a_e \leq 0.08D$ .<br>Neck Taper Angle 2° or above $a_e \leq 0.1D$ . |                    |                           |                       | Neck Taper Angle 1°30' or below $a_e \leq 0.06D$ .<br>Neck Taper Angle 2° or above $a_e \leq 0.08D$ . |  |                    |                           |                       |                |
|                   |                          |                  | Finishing                                  | $a_e \leq Vf / n$  |                    |                           |                       |   |  |                    |                           |                       |                |

## Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- The neck length and taper angle may affect the milling parameters. In operation, fine adjustments may be required.
- Recommend air blow or oil mist.
- Recommend oil coolant for Stainless Steels and Heat Resistant Alloys.
- Recommend water soluble or oil base coolant for Copper.

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size R0.5~R1

# DCTNB

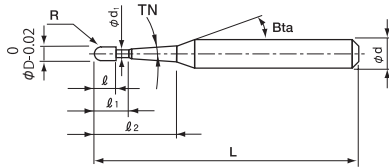
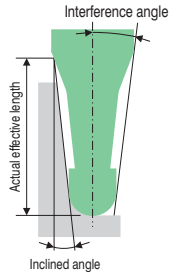
MG DIA 35° R ±0.01 Shank Dia 0/-0.005

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|                               |                                 |                                  |                 |        |        |        |        |           | ○               | ★        | ○      | ○        | ●                     |                 |                       |                  | ○                                     |

## Features

**2 Flute Diamond coated Taper Neck Ball End Mills for Graphite Electrodes.**  
**Taper Neck design improves the tool rigidity and provides high-efficiency & high-precision milling.**  
**Original and optimized Diamond coating offers outstanding resistance to wear on Graphite.**  
**Excellent adhesion coating with long-life tool design.**



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

Total 15 models

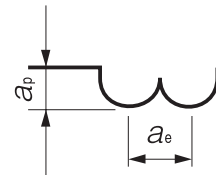
Unit (mm)

| Model Number        | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Effective Length $\ell_1$ | Length of Cut $\ell$ | Neck Diameter $\phi d_1$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ | Interference Angle | Effective Length by Inclined Angles<br>- : Interference |        |                 |                 |                 |
|---------------------|-----------------------|---------------------|----------------------|---------------------------|----------------------|--------------------------|-----------------------|------------------|-------------------------|--------------------------|--------------------|---|--------|-----------------|-----------------|-----------------|
|                     |                       |                     |                      |                           |                      |                          |                       |                  |                         |                          |                    | 30'   | 1°     | 1°30'           | 2°              | 3°              |
| DCTNB 2010-200-1.8  | R0.5                  | 0.9°                | 20                   | 4                         | 0.8                  | 0.96                     | 16°                   | 80               | 6                       | 18,730                   | 5.25°              | -   | 20.24  | 20.90           | 21.61           | 23.20           |
| DCTNB 2010-250-1.8  |                       |                     | 25                   |                           |                      |                          |                       | 80               | 6                       | 21,850                   | 4.48°              | -   | 25.27  | 26.10           | 26.99           | 28.98           |
| DCTNB 2010-400-1.8  |                       |                     | 40                   |                           |                      |                          |                       | 100              | 6                       | 25,470                   | 3.11°              | -   | 40.36  | 41.70           | 43.13           | 46.32           |
| DCTNB 2010-600-1.8  |                       |                     | 60                   |                           |                      |                          |                       | 120              | 6                       | 33,220                   | 2.21°              | -   | 60.49  | 62.50           | 64.65           | No Interference |
| DCTNB 2010-700-1.8  |                       |                     | 70                   |                           |                      |                          |                       | 120              | 6                       | 33,220                   | 1.93°              | -   | 70.55  | 72.90           | No Interference | No Interference |
| DCTNB 2010-800-1.8  |                       |                     | 80                   |                           |                      |                          |                       | 140              | 6                       | 33,490                   | 1.72°              | -   | 80.62  | 83.30           | No Interference | No Interference |
| DCTNB 2010-900-1.8  |                       |                     | 90                   |                           |                      |                          |                       | 150              | 6                       | 35,230                   | 1.54°              | -   | 90.68  | 93.71           | No Interference | No Interference |
| DCTNB 2020-200-1.8  | R1                    | 0.9°                | 20                   | 7                         | 1.6                  | 1.9                      | 16°                   | 80               | 6                       | 18,730                   | 4.55°              | -   | 20.34  | 21.00           | 21.69           | 23.25           |
| DCTNB 2020-250-1.8  |                       |                     | 25                   |                           |                      |                          |                       | 80               | 6                       | 21,850                   | 3.84°              | -   | 25.38  | 26.20           | 27.08           | 29.03           |
| DCTNB 2020-400-1.8  |                       |                     | 40                   |                           |                      |                          |                       | 100              | 6                       | 25,470                   | 2.61°              | -   | 40.47  | 41.80           | 43.22           | No Interference |
| DCTNB 2020-450-1.8  |                       |                     | 45                   |                           |                      |                          |                       | 100              | 6                       | 25,470                   | 2.36°              | -   | 45.51  | 47.00           | 48.60           | No Interference |
| DCTNB 2020-600-1.8  |                       |                     | 60                   |                           |                      |                          |                       | 120              | 6                       | 33,220                   | 1.83°              | -   | 60.59  | 62.59           | No Interference | No Interference |
| DCTNB 2020-700-1.8  |                       |                     | 70                   |                           |                      |                          |                       | 120              | 6                       | 33,220                   | 1.59°              | -   | 70.66  | 73.00           | No Interference | No Interference |
| DCTNB 2020-800-1.8  |                       |                     | 80                   |                           |                      |                          |                       | 140              | 6                       | 33,490                   | 1.41°              | -   | 80.72  | No Interference | No Interference | No Interference |
| DCTNB 2020-1000-1.8 |                       |                     | 100                  |                           |                      |                          |                       | 150              | 6                       | 37,910                   | 1.15°              | -   | 100.85 | No Interference | No Interference | No Interference |



## Milling Conditions for DCTNB

| WORK MATERIAL |                          |                  | GRAPHITE                           |                    |                        |                         |
|---------------|--------------------------|------------------|------------------------------------|--------------------|------------------------|-------------------------|
| Model Number  | Radius of Ball Nose (mm) | Neck Length (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 2010-200-1.8  | R0.5                     | 20               | 30,000                             | 1,500              | 0.1                    | 0.12                    |
| 2010-250-1.8  |                          | 25               | 30,000                             | 1,500              | 0.08                   | 0.12                    |
| 2010-400-1.8  |                          | 40               | 27,000                             | 1,200              | 0.07                   | 0.12                    |
| 2010-600-1.8  |                          | 60               | 23,000                             | 800                | 0.06                   | 0.12                    |
| 2010-700-1.8  |                          | 70               | 20,000                             | 600                | 0.05                   | 0.12                    |
| 2010-800-1.8  |                          | 80               | 18,000                             | 500                | 0.04                   | 0.12                    |
| 2010-900-1.8  |                          | 90               | 15,000                             | 400                | 0.03                   | 0.12                    |
| 2020-200-1.8  | R1                       | 20               | 27,000                             | 2,000              | 0.24                   | 0.5                     |
| 2020-250-1.8  |                          | 25               | 27,000                             | 2,000              | 0.19                   | 0.5                     |
| 2020-400-1.8  |                          | 40               | 27,000                             | 2,000              | 0.13                   | 0.4                     |
| 2020-450-1.8  |                          | 45               | 27,000                             | 2,000              | 0.11                   | 0.4                     |
| 2020-600-1.8  |                          | 60               | 23,000                             | 1,500              | 0.1                    | 0.3                     |
| 2020-700-1.8  |                          | 70               | 20,000                             | 1,200              | 0.09                   | 0.3                     |
| 2020-800-1.8  |                          | 80               | 17,000                             | 900                | 0.09                   | 0.2                     |
| 2020-10001.8  |                          | 100              | 14,000                             | 600                | 0.09                   | 0.2                     |



## Note:

- Use a milling machine dedicated for Graphite.
- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Recommend air blow for Graphite.

## Other series for Graphite milling

## Square / Long Neck Square

(★ Highly Recommended ● Recommended ○ Suggested)

| Number of Flutes, Tool Type | Model Number     | Appearance | Coating  | Size                   | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Hard Brittle (Non-Metallic) Materials | Page |
|-----------------------------|------------------|------------|----------|------------------------|-----------------|----------|--------|----------|-----------------------|---------------------------------------|------|
| 4 flutes Square             | <b>CGE</b>       |            | Non-coat | $\phi 2 \sim \phi 20$  | ○               | ★        | ○      | ○        | ○                     |                                       | 236  |
| 2 flutes Square             | <b>DCES 2000</b> |            | DIA      | $\phi 0.2 \sim \phi 6$ | ○               | ★        | ○      | ○        | ●                     | ○                                     | 188  |
| 4 flutes Square             | <b>DCES 4000</b> |            | DIA      | $\phi 3 \sim \phi 10$  | ○               | ★        | ○      | ○        | ●                     | ○                                     | 234  |
| 2 flutes Long Neck Square   | <b>DCLS</b>      |            | DIA      | $\phi 0.4 \sim \phi 6$ | ○               | ★        | ○      | ○        | ●                     | ○                                     | 266  |

## Long Neck Radius

|                           |              |  |     |                      |   |   |   |   |   |   |     |
|---------------------------|--------------|--|-----|----------------------|---|---|---|---|---|---|-----|
| 4 flutes Long Neck Radius | <b>DCLRS</b> |  | DIA | $\phi 1 \sim \phi 6$ | ○ | ★ | ○ | ○ | ● | ○ | 396 |
|---------------------------|--------------|--|-----|----------------------|---|---|---|---|---|---|-----|

## Ball / Long Neck Ball / Taper Neck Ball

|                          |                 |  |          |           |   |   |   |   |   |   |     |
|--------------------------|-----------------|--|----------|-----------|---|---|---|---|---|---|-----|
| 2 flutes Ball            | <b>CGB 2000</b> |  | Non-coat | R0.2 ~ R6 | ○ | ★ | ○ | ○ | ○ |   | 440 |
| 4 flutes Ball            | <b>CGB 4000</b> |  | Non-coat | R2 ~ R10  | ○ | ★ | ○ | ○ | ○ |   | 458 |
| 2 flutes Ball            | <b>DCB</b>      |  | DIA      | R0.5 ~ R6 | ○ | ★ | ○ | ○ | ● | ○ | 438 |
| 2 flutes Long Neck Ball  | <b>DCLB</b>     |  | DIA      | R0.2 ~ R3 | ○ | ★ | ○ | ○ | ● | ○ | 512 |
| 2 flutes Taper Neck Ball | <b>DCTNB</b>    |  | DIA      | R0.5 ~ R1 | ○ | ★ | ○ | ○ | ● | ○ | 556 |

3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Square

Long Neck Square

Radius

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Ball

Long Neck Ball

Taper Neck Ball

Taper

Taper

Barrel

Spiral V Cutter

Drill

Technical Data



Size R0.5~R2

# HFTNB



R0.5~R1.5

R2

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ○                             | ○                               | ●                                | ●               | ●      | ●      | ●      | ○      |           |                 |          |        |          | ○                     | ○               |                       |                  |                                       |

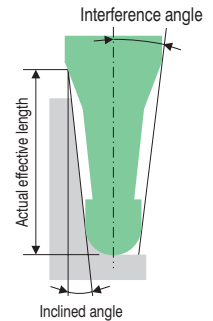
## Features

**3 Flute Taper Neck Ball End Mills for Hard Materials.**

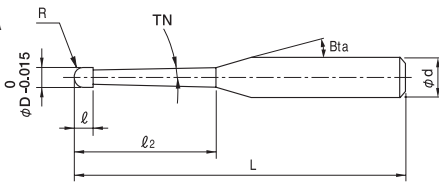
**The negative rake angle design improves wear resistance.**

**Back taper design reduces cutting resistance.**

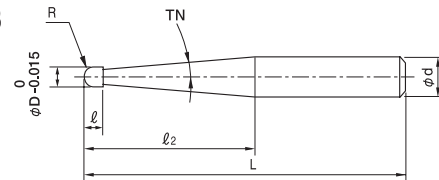
**Suitable for both roughing and finishing. Diameter Tolerance : 0/-0.015.**



Shape A

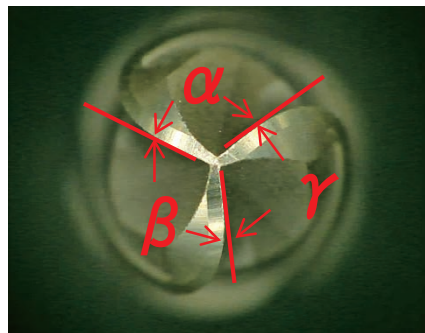


Shape B



The shank taper angle shown is not an exact value and to avoid contact with the work piece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

- **Variable Pitch design**  
Minimizing vibration and chattering



※ Variable Pitch  $\alpha \neq \beta \neq \gamma$

- **A wide choice of Taper Neck Angles**

Useful sizes:  $0.4^\circ \cdot 0.9^\circ \cdot 1.4^\circ \cdot 1.9^\circ \cdot 2.9^\circ$

Using with HTNRS, Taper Neck Radius End Mill, offers higher efficient milling.

Refer to page 412 for HTNRS.

Total 75 models

Unit (mm)

| Model Number      | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Shape  | Suggested Retail Price ¥ | Interference Angle | Effective Length by Inclined Angles<br>— : Interference |       |       |       |       |       |
|-------------------|-----------------------|---------------------|----------------------|----------------------|-----------------------|------------------|-------------------------|--------|--------------------------|--------------------|---|-------|-------|-------|-------|-------|
|                   |                       |                     |                      |                      |                       |                  |                         |        |                          |                    | 30'   | 1°    | 1°30' | 2°    | 3°    |       |
|                   |                       |                     |                      |                      |                       |                  |                         |        |                          |                    | HFTNB 3010-080-08                                       | RO.5  | 0.4°  | 8     | 0.8   | 16°   |
| HFTNB 3010-100-08 | 10                    | 60                  | 6                    | 8,690                | 7.89°                 | 10.07            | 10.38                   | 10.71  | 11.07                    | 11.87              |   |       |       |       |       |       |
| HFTNB 3010-120-08 | 12                    | 60                  | 6                    | 8,690                | 7.13°                 | 12.08            | 12.46                   | 12.86  | 13.29                    | 14.26              |   |       |       |       |       |       |
| HFTNB 3010-160-08 | 16                    | 60                  | 6                    | 8,690                | 5.98°                 | 16.10            | 16.61                   | 17.16  | 17.74                    | 19.03              |   |       |       |       |       |       |
| HFTNB 3010-200-08 | 20                    | 60                  | 6                    | 11,040               | 5.15°                 | 20.13            | 20.77                   | 21.45  | 22.18                    | 23.81              |   |       |       |       |       |       |
| HFTNB 3010-260-08 | 26                    | 70                  | 6                    | 11,590               | 4.26°                 | 26.17            | 27.00                   | 27.89  | 28.85                    | 30.97              |   |       |       |       |       |       |
| HFTNB 3010-300-08 | 30                    | 70                  | 6                    | 12,140               | 3.82°                 | 30.19            | 31.16                   | 32.19  | 33.29                    | 35.75              |   |       |       |       |       |       |
| HFTNB 3010-060-18 | 0.9°                  | 6                   | 60                   | 6                    | 8,690                 | 10.11°           | —                       | 6.06   | 6.25                     | 6.45               | 6.90  |       |       |       |       |       |
| HFTNB 3010-080-18 |                       | 8                   | 60                   | 6                    | 8,690                 | 8.94°            | —                       | 8.07   | 8.33                     | 8.60               | 9.21  |       |       |       |       |       |
| HFTNB 3010-100-18 |                       | 10                  | 60                   | 6                    | 8,690                 | 8.01°            | —                       | 10.08  | 10.41                    | 10.75              | 11.53   |       |       |       |       |       |
| HFTNB 3010-120-18 |                       | 12                  | 60                   | 6                    | 8,690                 | 7.25°            | —                       | 12.10  | 12.49                    | 12.91              | 13.84   |       |       |       |       |       |
| HFTNB 3010-160-18 |                       | 16                  | 60                   | 6                    | 8,690                 | 6.10°            | —                       | 16.12  | 16.65                    | 17.21              | 18.47   |       |       |       |       |       |
| HFTNB 3010-200-18 |                       | 20                  | 60                   | 6                    | 11,040                | 5.26°            | —                       | 20.15  | 20.81                    | 21.52              | 23.09   |       |       |       |       |       |
| HFTNB 3010-260-18 |                       | 26                  | 70                   | 6                    | 11,590                | 4.36°            | —                       | 26.19  | 27.05                    | 27.98              | 30.03   |       |       |       |       |       |
| HFTNB 3010-300-18 |                       | 30                  | 70                   | 6                    | 12,140                | 3.91°            | —                       | 30.21  | 31.21                    | 32.28              | 34.66   |       |       |       |       |       |
| HFTNB 3010-100-28 | 1.4°                  | 10                  | 60                   | 6                    | 8,690                 | 8.13°            | —                       | —      | 10.10                    | 10.43              | 11.18   |       |       |       |       |       |
| HFTNB 3010-120-28 |                       | 12                  | 60                   | 6                    | 8,690                 | 7.38°            | —                       | —      | 12.11                    | 12.52              | 13.42   |       |       |       |       |       |
| HFTNB 3010-160-28 |                       | 16                  | 60                   | 6                    | 8,690                 | 6.22°            | —                       | —      | 16.14                    | 16.68              | 17.90   |       |       |       |       |       |
| HFTNB 3010-200-28 |                       | 20                  | 60                   | 6                    | 11,040                | 5.37°            | —                       | —      | 20.17                    | 20.85              | 22.38   |       |       |       |       |       |
| HFTNB 3010-260-28 |                       | 26                  | 70                   | 6                    | 11,590                | 4.46°            | —                       | —      | 26.21                    | 27.10              | 29.09   |       |       |       |       |       |
| HFTNB 3015-100-08 |                       | RO.75               | 0.4°                 | 10                   | 1.2                   | 16°              | 60                      | 6      | A                        | 9,110              | 7.55°   | 10.11 | 10.41 | 10.74 | 11.09 | 11.87 |
| HFTNB 3015-160-08 |                       |                     |                      | 16                   |                       |                  | 60                      | 6      |                          | 9,940              | 5.64°   | 16.14 | 16.65 | 17.18 | 17.75 | 19.03 |
| HFTNB 3015-200-08 |                       |                     |                      | 20                   |                       |                  | 60                      | 6      |                          | 9,940              | 4.82°   | 20.17 | 20.80 | 21.48 | 22.20 | 23.81 |
| HFTNB 3015-300-08 | 30                    |                     |                      | 70                   |                       |                  | 6                       | 10,760 |                          | 3.54°              | 30.23   | 31.19 | 32.21 | 33.31 | 35.75 |       |
| HFTNB 3015-100-18 | 0.9°                  |                     | 10                   | 60                   | 6                     | 9,110            | 7.66°                   | —      | 10.13                    | 10.45              | 10.79   | 11.54 |       |       |       |       |
| HFTNB 3015-160-18 |                       |                     | 16                   | 60                   | 6                     | 9,940            | 5.75°                   | —      | 16.17                    | 16.69              | 17.24   | 18.48 |       |       |       |       |
| HFTNB 3015-200-18 |                       |                     | 20                   | 60                   | 6                     | 9,940            | 4.93°                   | —      | 20.19                    | 20.85              | 21.55   | 23.11 |       |       |       |       |
| HFTNB 3015-300-18 |                       |                     | 30                   | 70                   | 6                     | 10,760           | 3.63°                   | —      | 30.26                    | 31.25              | 32.31   | 34.67 |       |       |       |       |
| HFTNB 3015-100-28 | 1.4°                  |                     | 10                   | 60                   | 6                     | 9,110            | 7.79°                   | —      | —                        | 10.15              | 10.48   | 11.21 |       |       |       |       |
| HFTNB 3015-160-28 |                       |                     | 16                   | 60                   | 6                     | 9,940            | 5.87°                   | —      | —                        | 16.19              | 16.73   | 17.93 |       |       |       |       |
| HFTNB 3015-200-28 |                       |                     | 20                   | 60                   | 6                     | 9,940            | 5.03°                   | —      | —                        | 20.22              | 20.90   | 22.41 |       |       |       |       |
| HFTNB 3015-300-28 |                       |                     | 30                   | 80                   | 6                     | 10,760           | 3.72°                   | —      | —                        | 30.28              | 31.31   | 33.60 |       |       |       |       |

Next Page ➡

3 Flutes

Ø3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

| Model Number      | Radius of Ball Nose R | Neck Taper Angle TN | Neck Length $\ell_2$ | Length of Cut $\ell$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ | Shape | Suggested Retail Price ¥ | Interference Angle | Effective Length by Inclined Angles<br>- : Interference |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
|-------------------|-----------------------|---------------------|----------------------|----------------------|-----------------------|------------------|-------------------------|-------|--------------------------|--------------------|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                   |                       |                     |                      |                      |                       |                  |                         |       |                          |                    | 30'   | 1°              | 1°30'           | 2°              | 3°              |                 |                 |                 |                 |                 |                 |
|                   |                       |                     |                      |                      |                       |                  |                         |       |                          |                    |   |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-120-08 | R1                    | 0.4°                | 12                   | 1.6                  | 16°                   | 60               | 6                       | A     | 9,100                    | 6.40°              | 12.12   | 12.49           | 12.87           | 13.29           | 14.22           |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-160-08 |                       |                     | 16                   |                      |                       |                  |                         |       | 9,320                    | 5.27°              | 16.15   | 16.64           | 17.17           | 17.73           | 18.99           |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-200-08 |                       |                     | 20                   |                      |                       |                  |                         |       | 9,940                    | 4.47°              | 20.17   | 20.80           | 21.46           | 22.18           | 23.77           |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-220-08 |                       |                     | 22                   |                      |                       |                  |                         |       | 9,940                    | 4.16°              | 22.18   | 22.87           | 23.61           | 24.40           | 26.16           |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-260-08 |                       |                     | 26                   |                      |                       |                  |                         |       | 11,040                   | 3.65°              | 26.21   | 27.03           | 27.90           | 28.84           | 30.93           |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-300-08 |                       |                     | 30                   |                      |                       |                  |                         |       | 12,140                   | 3.25°              | 30.23   | 31.18           | 32.20           | 33.29           | 35.71           |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-320-08 |                       |                     | 32                   |                      |                       |                  |                         |       | 12,140                   | 3.08°              | 32.25   | 33.26           | 34.35           | 35.51           | 38.09           |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-360-08 |                       |                     | 36                   |                      |                       |                  |                         |       | 12,140                   | 2.79°              | 36.26   | 37.40           | 38.63           | 39.94           | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-400-08 |                       |                     | 40                   |                      |                       |                  |                         |       | 14,350                   | 2.55°              | 40.30   | 41.57           | 42.94           | 44.40           | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-120-18 |                       | 0.9°                | 12                   |                      |                       |                  |                         |       | 9,100                    | 6.52°              | —   | 12.15           | 12.52           | 12.93           | 13.83           |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-160-18 |                       |                     | 16                   |                      |                       |                  |                         |       | 9,320                    | 5.38°              | —   | 16.17           | 16.68           | 17.23           | 18.46           |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-200-18 |                       |                     | 20                   |                      |                       |                  |                         |       | 9,940                    | 4.57°              | —   | 20.20           | 20.85           | 21.54           | 23.08           |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-260-18 |                       |                     | 26                   |                      |                       |                  |                         |       | 11,040                   | 3.74°              | —   | 26.24           | 27.09           | 28.00           | 30.02           |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-300-18 |                       |                     | 30                   |                      |                       |                  |                         |       | 12,140                   | 3.33°              | —   | 30.26           | 31.25           | 32.30           | 34.65           |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-360-18 |                       |                     | 36                   |                      |                       |                  |                         |       | 12,140                   | 2.86°              | —   | 36.30           | 37.49           | 38.76           | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-400-18 |                       |                     | 40                   |                      |                       |                  |                         |       | 14,350                   | 2.62°              | —   | 40.33           | 41.65           | 43.06           | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-500-18 |                       |                     | 50                   |                      |                       |                  |                         |       | 16,000                   | 2.16°              | —   | 50.39           | 52.05           | 53.83           | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-160-28 |                       |                     | 1.4°                 |                      |                       |                  |                         |       | 16                       | 9,320              | 5.49°   | —               | —               | 16.20           | 16.73           | 17.92           |                 |                 |                 |                 |                 |
| HFTNB 3020-200-28 | 20                    | 9,940               |                      | 4.68°                | —                     | —                | 20.23                   | 20.90 | 22.40                    |                    |   |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-260-28 | 26                    | 11,040              |                      | 3.83°                | —                     | —                | 26.27                   | 27.15 | 29.11                    |                    |   |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-300-28 | 30                    | 12,140              |                      | 3.41°                | —                     | —                | 30.30                   | 31.32 | 33.59                    |                    |   |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-400-28 | 40                    | 15,070              |                      | 2.69°                | —                     | —                | 40.36                   | 41.73 | No Interference          |                    |   |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-620-38 | 1.9°                  | 62                  | —                    | 100                  | 6                     | B                | 18,000                  | —     | —                        | —                  | —   | No Interference | No Interference |                 |                 |                 |                 |                 |                 |                 |                 |
| HFTNB 3020-410-58 | 2.9°                  | 41                  | —                    | 80                   | 6                     | B                | 17,000                  | —     | —                        | —                  | —   | No Interference | No Interference |                 |                 |                 |                 |                 |                 |                 |                 |
| HFTNB 3030-200-08 | R1.5                  | 0.4°                | 20                   | 2.4                  | 16°                   | 60               | 6                       | A     | 11,200                   | 3.67°              | 20.23   | 20.84           | 21.49           | 22.19           | 23.75           |                 |                 |                 |                 |                 |                 |
| HFTNB 3030-260-08 |                       |                     | 26                   |                      |                       |                  |                         |       | 11,960                   | 2.94°              | 26.27   | 27.07           | 27.93           | 28.86           | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3030-300-08 |                       |                     | 30                   |                      |                       |                  |                         |       | 13,660                   | 2.60°              | 30.29   | 31.23           | 32.23           | 33.30           | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3030-320-08 |                       |                     | 32                   |                      |                       |                  |                         |       | 14,350                   | 2.46°              | 32.31   | 33.31           | 34.38           | 35.52           | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3030-360-08 |                       |                     | 36                   |                      |                       |                  |                         |       | 14,950                   | 2.21°              | 36.31   | 37.45           | 38.65           | 39.95           | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3030-400-08 |                       |                     | 40                   |                      |                       |                  |                         |       | 15,180                   | 2.01°              | 40.36   | 41.62           | 42.97           | 44.41           | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3030-200-18 |                       |                     | 0.9°                 |                      |                       |                  |                         |       | 20                       | 11,200             | 3.76°   | —               | 20.27           | 20.90           | 21.58           | 23.09           |                 |                 |                 |                 |                 |
| HFTNB 3030-300-18 |                       |                     |                      |                      |                       |                  |                         |       | 30                       | 13,660             | 2.67°   | —               | 30.34           | 31.31           | 32.34           | No Interference |                 |                 |                 |                 |                 |
| HFTNB 3030-400-18 |                       |                     |                      |                      |                       |                  |                         |       | 40                       | 15,180             | 2.07°   | —               | 40.40           | 41.71           | 43.11           | No Interference |                 |                 |                 |                 |                 |
| HFTNB 3030-500-18 |                       | 1.4°                | 50                   |                      |                       |                  |                         |       | 17,500                   | 1.69°              | —   | 50.46           | 52.11           | No Interference | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3030-600-18 |                       |                     | 60                   |                      |                       |                  |                         |       | 19,000                   | 1.43°              | —   | 60.52           | No Interference | No Interference | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3030-400-28 |                       |                     | 40                   |                      |                       |                  |                         |       | 15,180                   | 2.12°              | —   | —               | 40.45           | 41.80           | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3030-500-28 |                       |                     | 50                   |                      |                       |                  |                         |       | 17,000                   | 1.74°              | —   | —               | 50.51           | No Interference | No Interference |                 |                 |                 |                 |                 |                 |
| HFTNB 3030-650-28 |                       |                     | 65                   |                      |                       |                  |                         |       | —                        | 100                | 6   | B               | 19,000          | —               | —               | —               | No Interference | No Interference | No Interference |                 |                 |
| HFTNB 3040-300-18 |                       | R2                  | 0.9°                 |                      |                       |                  |                         |       | 30                       | 6                  | 16°   | 80              | 6               | A               | 13,330          | 1.90°           | —               | 30.51           | 31.47           | No Interference | No Interference |
| HFTNB 3040-400-18 |                       |                     |                      |                      |                       |                  |                         |       | 40                       |                    |   |                 |                 |                 | 17,250          | 1.45°           | —               | 40.58           | No Interference | No Interference | No Interference |
| HFTNB 3040-500-18 |                       |                     |                      |                      |                       |                  |                         |       | 50                       |                    |   |                 |                 |                 | 19,000          | 1.18°           | —               | 50.64           | No Interference | No Interference | No Interference |
| HFTNB 3040-600-18 |                       |                     |                      |                      |                       |                  |                         |       | 60                       |                    |   |                 |                 |                 | 20,200          | 0.99°           | —               | No Interference | No Interference | No Interference | No Interference |
| HFTNB 3040-480-28 | 1.4°                  |                     |                      | 48                   | —                     | 80               | 6                       | B     | 17,250                   |                    |   |                 |                 |                 | —               | —               | —               | No Interference | No Interference |                 |                 |

ø3mm Shank V Series

UDC-PCD Series

CBN Series

Square Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball Long Neck Ball Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

# Milling Conditions for HFTNB

3 Flutes

| WORK MATERIAL |                          |                  | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKH<br>(55~65HRC) |                    |                                 |                                  |
|---------------|--------------------------|------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Neck Length (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 3010          | R0.5                     | 6                | 14,500  | 1,300              | 0.1                             | 0.2                              | 14,500                                     | 1,250              | 0.06                            | 0.12                             | 14,500                                     | 1,200              | 0.04                            | 0.08                             |
|               |                          | 8                | 14,000  | 1,200              | 0.09                            | 0.18                             | 13,750                                     | 1,160              | 0.06                            | 0.1                              | 13,500                                     | 1,120              | 0.04                            | 0.06                             |
|               |                          | 10               | 13,300  | 1,000              | 0.08                            | 0.16                             | 12,650                                     | 1,000              | 0.05                            | 0.09                             | 12,000                                     | 1,000              | 0.04                            | 0.05                             |
|               |                          | 12               | 13,000  | 870                | 0.07                            | 0.14                             | 12,000                                     | 850                | 0.04                            | 0.08                             | 11,000                                     | 880                | 0.03                            | 0.05                             |
|               |                          | 16               | 12,500  | 680                | 0.05                            | 0.1                              | 10,250                                     | 600                | 0.04                            | 0.06                             | 8,000                                      | 550                | 0.03                            | 0.04                             |
|               |                          | 20               | 12,000  | 600                | 0.04                            | 0.08                             | 9,500                                      | 500                | 0.03                            | 0.06                             | 7,000                                      | 400                | 0.02                            | 0.04                             |
|               |                          | 26               | 11,700  | 520                | 0.03                            | 0.06                             | 8,600                                      | 370                | 0.02                            | 0.04                             | 5,500                                      | 220                | 0.02                            | 0.03                             |
|               |                          | 30               | 11,500  | 500                | 0.02                            | 0.05                             | 8,250                                      | 350                | 0.02                            | 0.04                             | 5,000                                      | 200                | 0.02                            | 0.03                             |
| 3015          | R0.75                    | 10               | 12,000  | 1,230              | 0.13                            | 0.3                              | 11,500                                     | 1,100              | 0.09                            | 0.2                              | 11,000                                     | 1,100              | 0.06                            | 0.14                             |
|               |                          | 16               | 11,200  | 930                | 0.1                             | 0.25                             | 10,600                                     | 910                | 0.07                            | 0.16                             | 10,000                                     | 900                | 0.05                            | 0.11                             |
|               |                          | 20               | 10,800  | 750                | 0.08                            | 0.22                             | 9,500                                      | 700                | 0.06                            | 0.14                             | 8,200                                      | 680                | 0.04                            | 0.09                             |
|               |                          | 30               | 10,000  | 550                | 0.06                            | 0.16                             | 8,300                                      | 450                | 0.04                            | 0.1                              | 6,600                                      | 380                | 0.03                            | 0.08                             |
| 3020          | R1                       | 12               | 10,300  | 1,200              | 0.16                            | 0.38                             | 10,150                                     | 1,130              | 0.12                            | 0.25                             | 10,000                                     | 1,100              | 0.1                             | 0.18                             |
|               |                          | 16               | 10,000  | 1,100              | 0.15                            | 0.35                             | 9,900                                      | 1,100              | 0.1                             | 0.23                             | 9,800                                      | 1,050              | 0.09                            | 0.16                             |
|               |                          | 20               | 9,500   | 950                | 0.15                            | 0.32                             | 9,300                                      | 940                | 0.1                             | 0.21                             | 9,000                                      | 930                | 0.08                            | 0.15                             |
|               |                          | 22               | 9,400   | 900                | 0.14                            | 0.3                              | 9,100                                      | 850                | 0.09                            | 0.2                              | 8,600                                      | 840                | 0.08                            | 0.14                             |
|               |                          | 26               | 9,300   | 750                | 0.12                            | 0.28                             | 8,700                                      | 730                | 0.08                            | 0.2                              | 8,000                                      | 700                | 0.07                            | 0.13                             |
|               |                          | 30               | 9,200   | 630                | 0.11                            | 0.25                             | 8,400                                      | 590                | 0.08                            | 0.17                             | 7,500                                      | 550                | 0.05                            | 0.1                              |
|               |                          | 32               | 8,800   | 580                | 0.1                             | 0.24                             | 8,200                                      | 550                | 0.07                            | 0.16                             | 7,300                                      | 480                | 0.04                            | 0.1                              |
|               |                          | 36               | 8,700   | 570                | 0.09                            | 0.22                             | 7,900                                      | 510                | 0.07                            | 0.16                             | 7,000                                      | 450                | 0.04                            | 0.1                              |
|               |                          | 40               | 8,300   | 500                | 0.08                            | 0.2                              | 7,500                                      | 450                | 0.06                            | 0.15                             | 6,600                                      | 400                | 0.04                            | 0.1                              |
|               |                          | 41               | 8,300   | 500                | 0.08                            | 0.2                              | 7,500                                      | 450                | 0.06                            | 0.15                             | 6,600                                      | 400                | 0.04                            | 0.1                              |
|               |                          | 50               | 8,000   | 430                | 0.06                            | 0.15                             | 6,700                                      | 340                | 0.04                            | 0.12                             | 5,300                                      | 250                | 0.03                            | 0.1                              |
|               |                          | 62               | 7,500   | 350                | 0.04                            | 0.1                              | 6,000                                      | 350                | 0.04                            | 0.13                             | 5,000                                      | 300                | 0.02                            | 0.05                             |
| 3030          | R1.5                     | 20               | 9,000   | 1,150              | 0.25                            | 0.48                             | 8,900                                      | 1,100              | 0.18                            | 0.36                             | 8,800                                      | 1,100              | 0.12                            | 0.25                             |
|               |                          | 26               | 8,600   | 1,000              | 0.22                            | 0.42                             | 8,300                                      | 1,000              | 0.16                            | 0.32                             | 8,200                                      | 980                | 0.11                            | 0.22                             |
|               |                          | 30               | 8,400   | 950                | 0.21                            | 0.4                              | 8,100                                      | 930                | 0.15                            | 0.3                              | 7,800                                      | 920                | 0.1                             | 0.21                             |
|               |                          | 32               | 8,300   | 900                | 0.2                             | 0.37                             | 7,800                                      | 860                | 0.14                            | 0.28                             | 7,400                                      | 840                | 0.09                            | 0.2                              |
|               |                          | 36               | 8,100   | 800                | 0.18                            | 0.35                             | 7,400                                      | 720                | 0.13                            | 0.26                             | 6,800                                      | 680                | 0.08                            | 0.2                              |
|               |                          | 40               | 8,000   | 720                | 0.17                            | 0.33                             | 7,000                                      | 630                | 0.12                            | 0.24                             | 6,000                                      | 550                | 0.08                            | 0.19                             |
|               |                          | 50               | 7,600   | 570                | 0.14                            | 0.28                             | 6,400                                      | 450                | 0.09                            | 0.2                              | 5,200                                      | 400                | 0.06                            | 0.17                             |
|               |                          | 60               | 7,200   | 480                | 0.12                            | 0.24                             | 6,000                                      | 400                | 0.07                            | 0.18                             | 4,700                                      | 320                | 0.05                            | 0.16                             |
|               |                          | 65               | 7,200   | 480                | 0.12                            | 0.24                             | 6,000                                      | 400                | 0.07                            | 0.18                             | 4,700                                      | 320                | 0.05                            | 0.16                             |

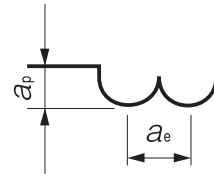
- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

Milling Conditions for HFTNB

| WORK MATERIAL |                          |                  | PREHARDENED STEELS / HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKT<br>(45~55HRC) |                    |                                 |                                  | HARDENED STEELS<br>SKD / SKH<br>(55~65HRC) |                    |                                 |                                  |
|---------------|--------------------------|------------------|---|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|--|--------------------|---------------------------------|----------------------------------|
| Model Number  | Radius of Ball Nose (mm) | Neck Length (mm) | Spindle Speed (min <sup>-1</sup> )                              | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )         | Feed Rate (mm/min) | a <sub>p</sub> Axial Depth (mm) | a <sub>e</sub> Radial Depth (mm) |
| 3040          | R2                       | 30               | 8,000   | 1,100              | 0.35                            | 0.55                             | 7,800                                      | 1,050              | 0.24                            | 0.4                              | 7,600                                      | 1,000              | 0.16                            | 0.33                             |
|               |                          | 40               | 7,500   | 930                | 0.3                             | 0.48                             | 7,300                                      | 900                | 0.2                             | 0.35                             | 7,000                                      | 900                | 0.15                            | 0.3                              |
|               |                          | 48               | 7,200   | 750                | 0.26                            | 0.42                             | 6,500                                      | 650                | 0.16                            | 0.3                              | 5,800                                      | 600                | 0.13                            | 0.27                             |
|               |                          | 50               | 7,200   | 750                | 0.26                            | 0.42                             | 6,500                                      | 650                | 0.16                            | 0.3                              | 5,800                                      | 600                | 0.13                            | 0.27                             |
|               |                          | 60               | 7,000   | 600                | 0.22                            | 0.36                             | 6,000                                      | 520                | 0.13                            | 0.26                             | 5,000                                      | 440                | 0.11                            | 0.25                             |

Note:

- Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed.
- Decrease the feed rate more than 50% from the milling parameters when slot milling.
- Every coolant offers stable milling.



Roughness Comparison

HFTNB R1 × Neck Length 20 × Neck Taper Angle 0.4° SKD61 (48HRC)



Work Size : 30 x 50 x 40 mm

| Measurement Spot | Surface Roughness Ra (μm) |            |
|------------------|---------------------------|------------|
|                  | HFTNB                     | Competitor |
| ①                | 0.353                     | 0.451      |
| ②                | 0.480                     | 0.865      |
| ③                | 0.200                     | 0.270      |
| ④                | 0.168                     | 0.248      |

Better surface roughness compared to competitor's!

| No. | Milling Process | Tool   | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Allowance (mm) | Coolant  | Cycle Time (h:m:s) |
|-----|-----------------|--|------------------------------------|--------------------|---------------------|---------------------|----------------|----------|--------------------|
| 1   | Roughing        | HSLB 2060-200 (R3 x EL20)  | 13,000                             | 3,500              | 0.6                 | 0.6                 | 0.05           |          | 0:25:33            |
| 2   | Semi-finishing  | HSLB 2030-200 (R1.5 x EL20)  | 14,500                             | 1,360              | 0.18                | 0.1                 | 0.02           | Air Blow | 0:49:48            |
| 3   | Finishing       | HFTNB 3020-200-08 / Competitor (R1 x Neck Length 20 x Neck Taper Angle 0.4°) | 4,650                              | 940                | 0.05                | 0.05                | 0              |          | 2:29:29            |

Total 3:44:50

## Taper Pocket Milling Examples

HFTNB R1 × Neck Length 30 × Neck Taper Angle 0.9°

SKD61 (50HRC)

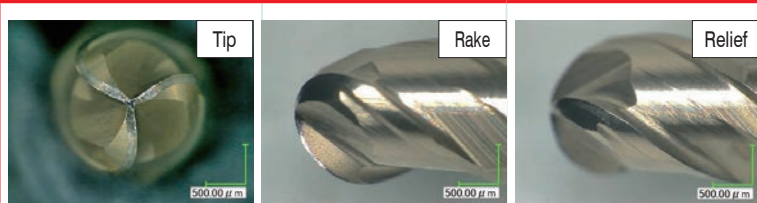
3 Flutes

Milling Shape : Taper Pocket 25 x 5 x Depth 4 mm Wall Inclined Angle 1°

Tools after milling

**HFTNB**

After 40 min



After 120 min



**Normal wear condition after 120 min milling. No chipping or any damages.**

Competitor A  
After 40 min



Chipping on the cutting edges of all 3 flutes after 40 min.

Competitor B  
After 40 min



Large chipping on the cutting edge after 40 min. Chipping also on the other 2 flutes.

**High durability throughout the long cycle time.**

| Tool              | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ (mm) | $a_e$ (mm) | Coolant  | Cycle Time      |
|-------------------|------------------------------------|--------------------|------------|------------|----------|-----------------|
| HFTNB 3020-300-18 | 8,400                              | 590                | 0.08       | 0.17       | Air Blow | 40 min / pocket |

- 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data





Size  $\phi 0.2 \sim \phi 2.5$

# C-CTE2000



$\phi 0.2 \sim \phi 0.4$   $\phi 0.5 \sim \phi 2.5$

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        |           |                 |          | ○      |          |                       |                 |                       |                  |                                       |

## Features

Extensive line up of tapered design from 30° to 15° of half included angle.  
Refer to page 568 for 4 flute C-CTE.

Total 108 models

Unit (mm)

| Model Number  | Tip Diameter | Half Included Angle | Length of Cut | Dia. at Large End | Overall Length | Shank Diameter | Suggested Retail Price<br>¥ |
|---------------|--------------|---------------------|---------------|-------------------|----------------|----------------|-----------------------------|
| C-CTE 2002-1  | 0.2          | 30°                 | 0.8           | 0.21              | 38             | 3              | 15,500                      |
| C-CTE 2002-2  |              | 1°                  |               | 0.23              | 38             | 3              | 15,500                      |
| C-CTE 2002-3  |              | 1°30'               |               | 0.24              | 38             | 3              | 15,500                      |
| C-CTE 2002-4  |              | 2°                  |               | 0.26              | 38             | 3              | 15,500                      |
| C-CTE 2002-6  |              | 3°                  |               | 0.28              | 38             | 3              | 15,500                      |
| C-CTE 2002-8  |              | 4°                  |               | 0.31              | 38             | 3              | 16,500                      |
| C-CTE 2002-10 |              | 5°                  |               | 0.34              | 38             | 3              | 18,500                      |
| C-CTE 2002-14 |              | 7°                  |               | 0.40              | 38             | 3              | 20,000                      |
| C-CTE 2002-20 |              | 10°                 |               | 0.48              | 38             | 3              | 22,000                      |
| C-CTE 2003-1  |              | 0.3                 |               | 30°               | 1.2            | 0.32           | 38                          |
| C-CTE 2003-2  | 1°           |                     | 0.34          | 38                |                | 3              | 13,000                      |
| C-CTE 2003-3  | 1°30'        |                     | 0.36          | 38                |                | 3              | 13,000                      |
| C-CTE 2003-4  | 2°           |                     | 0.38          | 38                |                | 3              | 13,000                      |
| C-CTE 2003-6  | 3°           |                     | 0.43          | 38                |                | 3              | 13,000                      |
| C-CTE 2003-8  | 4°           |                     | 0.47          | 38                |                | 3              | 14,000                      |
| C-CTE 2003-10 | 5°           |                     | 0.51          | 38                |                | 3              | 15,000                      |
| C-CTE 2003-14 | 7°           |                     | 0.59          | 38                |                | 3              | 16,500                      |
| C-CTE 2003-20 | 10°          |                     | 0.72          | 38                |                | 3              | 18,500                      |

Next Page ➡



Unit (mm)

| Model Number  | Tip Diameter | Half Included Angle | Length of Cut | Dia. at Large End | Overall Length | Shank Diameter | Suggested Retail Price ¥ |   |        |
|---------------|--------------|---------------------|---------------|-------------------|----------------|----------------|--------------------------|---|--------|
| C-CTE 2004-1  | 0.4          | 30°                 | 1.6           | 0.43              | 38             | 3              | 13,000                   |   |        |
| C-CTE 2004-2  |              | 1°                  |               | 0.46              | 38             | 3              | 13,000                   |   |        |
| C-CTE 2004-3  |              | 1°30'               |               | 0.48              | 38             | 3              | 13,000                   |   |        |
| C-CTE 2004-4  |              | 2°                  |               | 0.51              | 38             | 3              | 13,000                   |   |        |
| C-CTE 2004-6  |              | 3°                  |               | 0.57              | 38             | 3              | 13,000                   |   |        |
| C-CTE 2004-8  |              | 4°                  |               | 0.62              | 38             | 3              | 14,000                   |   |        |
| C-CTE 2004-10 |              | 5°                  |               | 0.68              | 38             | 3              | 15,000                   |   |        |
| C-CTE 2004-14 |              | 7°                  |               | 0.79              | 38             | 3              | 16,500                   |   |        |
| C-CTE 2004-20 |              | 10°                 |               | 0.96              | 38             | 3              | 18,500                   |   |        |
| C-CTE 2005-1  |              | 0.5                 |               | 30°               | 2              | 0.53           | 38                       | 3 | 12,960 |
| C-CTE 2005-2  | 1°           |                     | 0.57          | 38                |                | 3              | 12,960                   |   |        |
| C-CTE 2005-3  | 1°30'        |                     | 0.60          | 38                |                | 3              | 12,960                   |   |        |
| C-CTE 2005-4  | 2°           |                     | 0.64          | 38                |                | 3              | 12,960                   |   |        |
| C-CTE 2005-6  | 3°           |                     | 0.71          | 38                |                | 3              | 12,960                   |   |        |
| C-CTE 2005-8  | 4°           |                     | 0.78          | 38                |                | 3              | 14,040                   |   |        |
| C-CTE 2005-10 | 5°           |                     | 0.85          | 38                |                | 3              | 15,120                   |   |        |
| C-CTE 2005-14 | 7°           |                     | 0.99          | 38                |                | 3              | 17,280                   |   |        |
| C-CTE 2005-20 | 10°          |                     | 1.21          | 38                |                | 3              | 18,360                   |   |        |
| C-CTE 2005-24 | 12°          |                     | 1.35          | 38                |                | 3              | 18,960                   |   |        |
| C-CTE 2005-30 | 15°          |                     | 1.57          | 38                |                | 3              | 19,680                   |   |        |
| C-CTE 2006-1  | 0.6          |                     | 30°           | 2                 |                | 0.63           | 38                       | 3 | 12,120 |
| C-CTE 2006-2  |              |                     | 1°            |                   |                | 0.67           | 38                       | 3 | 12,120 |
| C-CTE 2006-3  |              |                     | 1°30'         |                   |                | 0.70           | 38                       | 3 | 12,120 |
| C-CTE 2006-4  |              | 2°                  | 0.74          |                   | 38             | 3              | 12,120                   |   |        |
| C-CTE 2006-5  |              | 2°30'               | 0.77          |                   | 38             | 3              | 12,120                   |   |        |
| C-CTE 2006-6  |              | 3°                  | 0.81          |                   | 38             | 3              | 12,120                   |   |        |
| C-CTE 2006-10 |              | 5°                  | 0.95          |                   | 38             | 3              | 14,280                   |   |        |
| C-CTE 2006-14 |              | 7°                  | 1.09          |                   | 38             | 3              | 16,440                   |   |        |
| C-CTE 2006-20 |              | 10°                 | 1.31          |                   | 38             | 3              | 17,520                   |   |        |
| C-CTE 2006-24 |              | 12°                 | 1.45          |                   | 38             | 3              | 18,000                   |   |        |
| C-CTE 2006-30 |              | 15°                 | 1.67          |                   | 38             | 3              | 18,600                   |   |        |
| C-CTE 2008-1  |              | 0.8                 | 30°           |                   | 3              | 0.85           | 38                       | 3 | 12,120 |
| C-CTE 2008-2  |              |                     | 1°            |                   |                | 0.90           | 38                       | 3 | 12,120 |
| C-CTE 2008-3  | 1°30'        |                     | 0.96          | 38                |                | 3              | 12,120                   |   |        |
| C-CTE 2008-4  | 2°           |                     | 1.01          | 38                |                | 3              | 12,120                   |   |        |
| C-CTE 2008-5  | 2°30'        |                     | 1.06          | 38                |                | 3              | 12,120                   |   |        |
| C-CTE 2008-6  | 3°           |                     | 1.11          | 38                |                | 3              | 12,120                   |   |        |
| C-CTE 2008-10 | 5°           |                     | 1.32          | 38                |                | 3              | 14,280                   |   |        |
| C-CTE 2008-14 | 7°           |                     | 1.54          | 38                |                | 3              | 16,440                   |   |        |
| C-CTE 2008-20 | 10°          |                     | 1.86          | 38                |                | 3              | 17,520                   |   |        |
| C-CTE 2008-24 | 12°          |                     | 2.08          | 38                |                | 3              | 18,000                   |   |        |
| C-CTE 2008-30 | 15°          |                     | 2.41          | 38                |                | 3              | 18,600                   |   |        |
| C-CTE 2010-1  | 1            |                     | 30°           | 4                 |                | 1.07           | 45                       | 4 | 9,480  |
| C-CTE 2010-2  |              |                     | 1°            |                   |                | 1.14           | 45                       | 4 | 9,480  |
| C-CTE 2010-3  |              | 1°30'               | 1.21          |                   | 45             | 4              | 9,480                    |   |        |

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Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Unit (mm)

| Model Number  | Tip Diameter | Half Included Angle | Length of Cut | Dia. at Large End | Overall Length | Shank Diameter | Suggested Retail Price ¥ |   |       |
|---------------|--------------|---------------------|---------------|-------------------|----------------|----------------|--------------------------|---|-------|
| C-CTE 2010-4  | 1            | 2°                  | 4             | 1.28              | 45             | 4              | 9,480                    |   |       |
| C-CTE 2010-5  |              | 2°30'               |               | 1.35              | 45             | 4              | 9,480                    |   |       |
| C-CTE 2010-6  |              | 3°                  |               | 1.42              | 45             | 4              | 9,720                    |   |       |
| C-CTE 2010-8  |              | 4°                  |               | 1.56              | 45             | 4              | 11,760                   |   |       |
| C-CTE 2010-10 |              | 5°                  |               | 1.70              | 45             | 4              | 11,760                   |   |       |
| C-CTE 2010-14 |              | 7°                  |               | 1.98              | 45             | 4              | 15,720                   |   |       |
| C-CTE 2010-20 |              | 10°                 |               | 2.41              | 45             | 4              | 16,800                   |   |       |
| C-CTE 2010-24 |              | 12°                 |               | 2.70              | 45             | 4              | 18,000                   |   |       |
| C-CTE 2010-30 |              | 15°                 |               | 3.14              | 50             | 6              | 18,720                   |   |       |
| C-CTE 2015-1  |              | 1.5                 |               | 30'               | 5              | 1.59           | 45                       | 4 | 9,480 |
| C-CTE 2015-2  | 1°           |                     | 1.67          | 45                |                | 4              | 9,480                    |   |       |
| C-CTE 2015-3  | 1°30'        |                     | 1.76          | 45                |                | 4              | 9,480                    |   |       |
| C-CTE 2015-4  | 2°           |                     | 1.85          | 45                |                | 4              | 9,480                    |   |       |
| C-CTE 2015-5  | 2°30'        |                     | 1.94          | 45                |                | 4              | 9,480                    |   |       |
| C-CTE 2015-6  | 3°           |                     | 2.02          | 45                |                | 4              | 9,720                    |   |       |
| C-CTE 2015-8  | 4°           |                     | 2.20          | 45                |                | 4              | 11,760                   |   |       |
| C-CTE 2015-10 | 5°           |                     | 2.37          | 45                |                | 4              | 11,760                   |   |       |
| C-CTE 2015-14 | 7°           |                     | 2.73          | 45                |                | 4              | 15,720                   |   |       |
| C-CTE 2015-20 | 10°          |                     | 3.26          | 45                |                | 4              | 16,800                   |   |       |
| C-CTE 2015-24 | 12°          |                     | 3.63          | 45                |                | 4              | 18,000                   |   |       |
| C-CTE 2015-30 | 15°          |                     | 4.18          | 50                |                | 6              | 18,720                   |   |       |
| C-CTE 2020-1  | 2            |                     | 30'           | 6                 |                | 2.10           | 45                       | 4 | 9,480 |
| C-CTE 2020-2  |              |                     | 1°            |                   |                | 2.21           | 45                       | 4 | 9,480 |
| C-CTE 2020-3  |              |                     | 1°30'         |                   |                | 2.31           | 45                       | 4 | 9,480 |
| C-CTE 2020-4  |              | 2°                  | 2.42          |                   | 45             | 4              | 9,480                    |   |       |
| C-CTE 2020-5  |              | 2°30'               | 2.52          |                   | 45             | 4              | 9,480                    |   |       |
| C-CTE 2020-6  |              | 3°                  | 2.63          |                   | 45             | 4              | 9,720                    |   |       |
| C-CTE 2020-8  |              | 4°                  | 2.84          |                   | 45             | 4              | 10,080                   |   |       |
| C-CTE 2020-10 |              | 5°                  | 3.05          |                   | 45             | 4              | 11,200                   |   |       |
| C-CTE 2020-14 |              | 7°                  | 3.47          |                   | 45             | 4              | 15,720                   |   |       |
| C-CTE 2020-20 |              | 10°                 | 4.12          |                   | 50             | 6              | 18,720                   |   |       |
| C-CTE 2020-24 | 12°          | 4.55                | 50            | 6                 | 19,680         |                |                          |   |       |
| C-CTE 2020-30 | 15°          | 5.22                | 50            | 6                 | 20,640         |                |                          |   |       |
| C-CTE 2025-1  | 2.5          | 30'                 | 8             | 2.64              | 45             | 4              | 10,800                   |   |       |
| C-CTE 2025-2  |              | 1°                  |               | 2.78              | 45             | 4              | 10,800                   |   |       |
| C-CTE 2025-3  |              | 1°30'               |               | 2.92              | 45             | 4              | 10,800                   |   |       |
| C-CTE 2025-4  |              | 2°                  |               | 3.06              | 45             | 4              | 10,800                   |   |       |
| C-CTE 2025-5  |              | 2°30'               |               | 3.20              | 45             | 4              | 10,800                   |   |       |
| C-CTE 2025-6  |              | 3°                  |               | 3.34              | 45             | 4              | 10,800                   |   |       |
| C-CTE 2025-8  |              | 4°                  |               | 3.62              | 45             | 4              | 11,100                   |   |       |
| C-CTE 2025-10 |              | 5°                  |               | 3.90              | 45             | 4              | 11,400                   |   |       |
| C-CTE 2025-14 |              | 7°                  |               | 4.45              | 45             | 6              | 13,340                   |   |       |
| C-CTE 2025-20 |              | 10°                 |               | 5.32              | 50             | 6              | 24,150                   |   |       |
| C-CTE 2025-24 |              | 12°                 |               | 5.90              | 50             | 8              | 26,400                   |   |       |
| C-CTE 2025-30 |              | 15°                 |               | 6.79              | 50             | 8              | 27,500                   |   |       |

ø3mm Shank V Series

UDC-PCD Series

CBN Series

Square Long Neck Square

Radius

Long Neck Radius Taper Neck Radius

Ball / Long Shank Ball Long Neck Ball

Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

## Milling Conditions for C-CTE (2 Flutes)

| WORK MATERIAL |                   | CARBON STEELS<br>ALLOY STEELS<br>(~325HB) |                    | TOOL STEELS<br>PREHARDENED STEELS<br>(30~40HRC) |                    | PREHARDENED STEELS<br>HARDENED STEELS<br>(40~50HRC) |                    |
|---------------|-------------------|---|--------------------|---|--------------------|---|--------------------|
| Model Number  | Tip Diameter (mm) | Spindle Speed (min <sup>-1</sup> )        | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> )              | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) |
| <b>2002</b>   | <b>0.2</b>        | 32,000                                    | 45                 | 25,000  | 30                 | 18,000  | 20                 |
| <b>2003</b>   | <b>0.3</b>        | 30,000                                    | 50                 | 23,000  | 30                 | 16,200  | 25                 |
| <b>2004</b>   | <b>0.4</b>        | 28,000                                    | 60                 | 21,000  | 35                 | 14,500  | 25                 |
| <b>2005</b>   | <b>0.5</b>        | 25,500                                    | 70                 | 19,100  | 40                 | 12,700  | 25                 |
| <b>2006</b>   | <b>0.6</b>        | 21,300                                    | 70                 | 15,900  | 40                 | 10,600  | 25                 |
| <b>2008</b>   | <b>0.8</b>        | 15,900                                    | 100                | 11,900  | 60                 | 8,000   | 40                 |
| <b>2010</b>   | <b>1</b>          | 12,800                                    | 150                | 9,600   | 110                | 6,400   | 70                 |
| <b>2015</b>   | <b>1.5</b>        | 8,500                                     | 150                | 6,400   | 110                | 4,300   | 70                 |
| <b>2020</b>   | <b>2</b>          | 6,400                                     | 150                | 4,800   | 110                | 3,200   | 70                 |
| <b>2025</b>   | <b>2.5</b>        | 5,100                                     | 150                | 3,800   | 110                | 2,600   | 70                 |

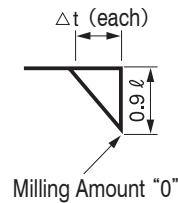
Milling Amount for Side Milling (mm)

$\varnothing$  = Length of Cut

$\Delta t = \tan \text{Half Included Taper Angle} \times 0.9 \varnothing$

Note:

- Recommend water soluble or oil coolant.
- Recommend wet coolant for Copper.



Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 3 \sim \phi 10$

# C-CTE4000



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        |           |                 |          | ○      |          |                       |                 |                       |                  |                                       |

## Features

Extensive line up of tapered design from 30° to 7° of half included angle.  
Refer to page 564 for 2 flute C-CTE.

Total 46 models

Unit (mm)

| Model Number  | Tip Diameter | Half Included Angle | Length of Cut | Dia. at Large End | Overall Length | Shank Diameter | Suggested Retail Price<br>¥ |
|---------------|--------------|---------------------|---------------|-------------------|----------------|----------------|-----------------------------|
| C-CTE 4030-1  | 3            | 30°                 | 10            | 3.17              | 50             | 6              | 11,340                      |
| C-CTE 4030-2  |              | 1°                  |               | 3.35              | 50             | 6              | 11,340                      |
| C-CTE 4030-3  |              | 1°30'               |               | 3.52              | 50             | 6              | 11,340                      |
| C-CTE 4030-4  |              | 2°                  |               | 3.70              | 50             | 6              | 11,340                      |
| C-CTE 4030-5  |              | 2°30'               |               | 3.87              | 50             | 6              | 11,340                      |
| C-CTE 4030-6  |              | 3°                  |               | 4.05              | 50             | 6              | 11,340                      |
| C-CTE 4030-10 |              | 5°                  |               | 4.75              | 50             | 6              | 12,290                      |
| C-CTE 4030-14 |              | 7°                  |               | 5.46              | 50             | 6              | 13,650                      |
| C-CTE 4040-1  | 4            | 30°                 | 15            | 4.26              | 50             | 6              | 11,760                      |
| C-CTE 4040-2  |              | 1°                  |               | 4.52              | 50             | 6              | 11,760                      |
| C-CTE 4040-3  |              | 1°30'               |               | 4.79              | 50             | 6              | 11,760                      |
| C-CTE 4040-4  |              | 2°                  |               | 5.05              | 50             | 6              | 11,760                      |
| C-CTE 4040-5  |              | 2°30'               |               | 5.31              | 50             | 6              | 11,760                      |
| C-CTE 4040-6  |              | 3°                  |               | 5.57              | 50             | 6              | 11,760                      |
| C-CTE 4040-10 |              | 5°                  |               | 6.63              | 50             | 8              | 16,280                      |
| C-CTE 4040-14 |              | 7°                  |               | 7.68              | 50             | 8              | 18,150                      |

Next Page ➔

Unit (mm)

| Model Number  | Tip Diameter | Half Included Angle | Length of Cut | Dia. at Large End | Overall Length | Shank Diameter | Suggested Retail Price ¥ |
|---------------|--------------|---------------------|---------------|-------------------|----------------|----------------|--------------------------|
| C-CTE 4050-1  | 5            | 30°                 | 20            | 5.35              | 60             | 6              | 13,650                   |
| C-CTE 4050-2  |              | 1°                  |               | 5.70              | 60             | 6              | 13,650                   |
| C-CTE 4050-3  |              | 1°30'               |               | 6.05              | 60             | 8              | 14,300                   |
| C-CTE 4050-4  |              | 2°                  |               | 6.40              | 60             | 8              | 14,300                   |
| C-CTE 4050-5  |              | 2°30'               |               | 6.75              | 60             | 8              | 14,300                   |
| C-CTE 4050-6  |              | 3°                  |               | 7.10              | 60             | 8              | 14,300                   |
| C-CTE 4050-10 |              | 5°                  |               | 8.50              | 60             | 10             | 21,780                   |
| C-CTE 4050-14 |              | 7°                  |               | 9.91              | 60             | 10             | 24,200                   |
| C-CTE 4060-1  | 6            | 30°                 | 20            | 6.35              | 60             | 8              | 14,300                   |
| C-CTE 4060-2  |              | 1°                  |               | 6.70              | 60             | 8              | 14,300                   |
| C-CTE 4060-3  |              | 1°30'               |               | 7.05              | 60             | 8              | 14,300                   |
| C-CTE 4060-4  |              | 2°                  |               | 7.40              | 60             | 8              | 14,300                   |
| C-CTE 4060-5  |              | 2°30'               |               | 7.75              | 60             | 8              | 15,840                   |
| C-CTE 4060-6  |              | 3°                  |               | 8.10              | 60             | 10             | 15,840                   |
| C-CTE 4060-10 |              | 5°                  |               | 9.50              | 60             | 10             | 23,320                   |
| C-CTE 4060-14 |              | 7°                  |               | 10.91             | 60             | 12             | 25,960                   |
| C-CTE 4080-1  | 8            | 30°                 | 25            | 8.44              | 70             | 10             | 22,440                   |
| C-CTE 4080-2  |              | 1°                  |               | 8.87              | 70             | 10             | 23,100                   |
| C-CTE 4080-3  |              | 1°30'               |               | 9.31              | 70             | 10             | 24,750                   |
| C-CTE 4080-4  |              | 2°                  |               | 9.75              | 70             | 10             | 26,070                   |
| C-CTE 4080-5  |              | 2°30'               |               | 10.18             | 75             | 12             | 28,600                   |
| C-CTE 4080-6  |              | 3°                  |               | 10.62             | 75             | 12             | 30,360                   |
| C-CTE 4080-10 |              | 5°                  |               | 12.37             | 90             | 12             | 52,800                   |
| C-CTE 4100-1  |              | 10                  |               | 30°               | 35             | 10.61          | 90                       |
| C-CTE 4100-2  | 1°           |                     | 11.22         | 90                |                | 12             | 40,260                   |
| C-CTE 4100-3  | 1°30'        |                     | 11.83         | 90                |                | 12             | 42,900                   |
| C-CTE 4100-4  | 2°           |                     | 12.44         | 90                |                | 12             | 49,500                   |
| C-CTE 4100-5  | 2°30'        |                     | 13.05         | 90                |                | 12             | 53,900                   |
| C-CTE 4100-6  | 3°           |                     | 13.67         | 90                |                | 12             | 57,750                   |
| C-CTE 4100-10 | 5°           |                     | 16.12         | 90                |                | 16             | 69,300                   |

4 Flutes

Ø3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Milling Conditions for C-CTE (4 Flutes)

| WORK MATERIAL |                   | CARBON STEELS<br>ALLOY STEELS<br>(~325HB) |                    | TOOL STEELS<br>PREHARDENED STEELS<br>(30~40HRC) |                    | PREHARDENED STEELS<br>HARDENED STEELS<br>(40~50HRC) |                    |
|---------------|-------------------|---|--------------------|---|--------------------|---|--------------------|
| Model Number  | Tip Diameter (mm) | Spindle Speed (min <sup>-1</sup> )        | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> )              | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> )                  | Feed Rate (mm/min) |
| <b>4030</b>   | <b>3</b>          | 4,200                                     | 200                | 3,200   | 150                | 2,100   | 90                 |
| <b>4040</b>   | <b>4</b>          | 3,200                                     | 200                | 2,400   | 150                | 1,600   | 90                 |
| <b>4050</b>   | <b>5</b>          | 2,600                                     | 200                | 1,900   | 150                | 1,300   | 90                 |
| <b>4060</b>   | <b>6</b>          | 2,100                                     | 200                | 1,600   | 150                | 1,100   | 90                 |
| <b>4080</b>   | <b>8</b>          | 1,600                                     | 200                | 1,200   | 150                | 800   | 90                 |
| <b>4100</b>   | <b>10</b>         | 1,300                                     | 200                | 1,000   | 150                | 600   | 90                 |

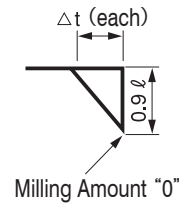
Milling Amount for Side Milling(mm)

$\ell$  = Length of Cut

$\Delta t = \tan \text{Half Included Taper Angle} \times 0.9 \ell$

Note:

- Recommend water soluble or oil coolant.
- Recommend wet coolant for Copper.



φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball  
Taper Neck Ball

Taper

Barrel

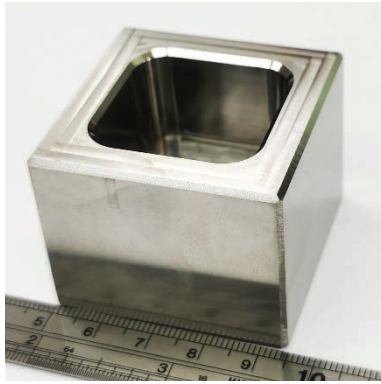
Spiral V Cutter

Drill

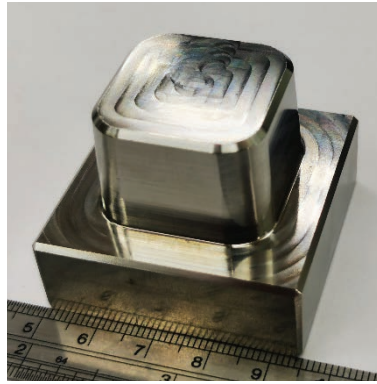
Technical Data

# Milling Example of Convex and Concave

STAVAX (52HRC)



**4 Flute Highly Efficient Radius HRRS**



**4 Flute Taper End Mill C-CTE4000**



Work Size  
45 × 45 × 35 mm



| Tool  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | a <sub>p</sub> (mm) | a <sub>e</sub> (mm) | Cycle Time (m:s) |
|---|------------------------------------|--------------------|---------------------|---------------------|------------------|
| 4 Flute Highly Efficient Radius HRRS<br>φ6 × CR0.5              | 6,500                              | 600                | 0.02                | 2.5                 | 3min 7 sec       |
| 4 Flute Taper End Mill C-CTE4000<br>φ6 × Half Included Angle 3° | 2,200                              | 300                | 20                  | 0.03                | 1min 43 sec      |

4 Flutes

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taper  
Taper

Barrel

Spiral V Cutter

Drill

Technical Data



# COVB

Super  
MG

UT  
COAT

Form  
±0.01

Shank Dia  
0/-0.005

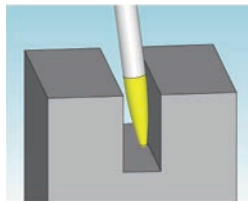
**NEW**

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        | ○         | ●               |          | ●      |          |                       | ○               | ○                     |                  |                                       |

**Features**

Broad range of application available with UTCOAT.  
Suitable for narrow interference area with small inclined angle.



Total 4 models

Unit (mm)

| Model Number           | Tip R<br>R1 | Barrel R<br>R2 | Length of Cut<br>ℓ | Overall Length<br>L | Shank Diameter<br>φd | Suggested Retail Price<br>¥ |
|------------------------|-------------|----------------|--------------------|---------------------|----------------------|-----------------------------|
| <b>COVB 4020-85</b>    | R1          | R85            | 19.2               | 60                  | 6                    | 23,400                      |
| <b>COVB 4020-90</b>    |             | R90            | 23.9               | 70                  | 8                    | 29,000                      |
| <b>COVB 4040-80</b>    | R2          | R80            | 23.4               | 80                  | 10                   | 33,330                      |
| <b>COVB 4040-80-12</b> |             | R80            | 26.6               | 80                  | 12                   | 40,320                      |

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

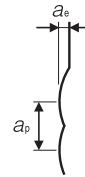


## Milling Conditions for COVB

| WORK MATERIAL |            |               | ALUMINUM ALLOYS<br>A7075           |                    |                        |                         | PREHARDENED STEELS<br>PXA30(30~45HRC) |                    |                        |                         | HARDENED STEELS<br>SKD61 / STAVAX(45~55HRC) |                    |                        |                         |
|---------------|------------|---------------|------------------------------------|--------------------|------------------------|-------------------------|---------------------------------------|--------------------|------------------------|-------------------------|---|--------------------|------------------------|-------------------------|
| Model Number  | Tip R (mm) | Barrel R (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )    | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )          | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 4020-85       | R1         | R85           | 10,500                             | 2,400              | 2.85                   | 0.1                     | 4,700                                 | 1,070              | 2.4                    | 0.1                     | 3,800                                       | 900                | 1.9                    | 0.07                    |
| 4020-90       |            | R90           | 9,250                              | 2,200              | 3.6                    | 0.1                     | 4,250                                 | 980                | 2.9                    | 0.1                     | 3,500                                       | 850                | 2.4                    | 0.07                    |
| 4040-80       | R2         | R80           | 8,000                              | 2,000              | 3.5                    | 0.1                     | 3,800                                 | 900                | 3                      | 0.1                     | 3,200                                       | 800                | 2.4                    | 0.07                    |
| 4040-80-12    |            | R80           | 6,750                              | 1,800              | 4                      | 0.1                     | 3,350                                 | 900                | 3.4                    | 0.1                     | 2,900                                       | 750                | 2.7                    | 0.07                    |

**Note:**

·Set spindle speed, feed rate, and axial depth ( $a_p$ ) in accordance with the required surface quality.



4 Flutes

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



# CSTB

Super  
MG

UT  
COAT

Form  
±0.01

Shank Dia  
0/-0.005

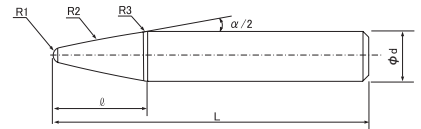
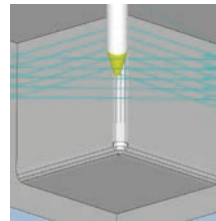
**NEW**

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        | ○         | ●               |          | ●      |          |                       | ○               | ○                     |                  |                                       |

**Features**

**Broad range of application available with UTCOAT.  
Suitable for finishing on straight and inclined walls with larger barrel R.**



Total 5 models

Unit (mm)

| Model Number            | Half Included Angle $\alpha/2$ | Tip R<br>R1 | Barrel R<br>R2 | Third R<br>R3 | Length of Cut<br>$\ell$ | Overall Length<br>L | Shank Diameter<br>$\phi d$ | Suggested Retail Price<br>¥ |
|-------------------------|--------------------------------|-------------|----------------|---------------|-------------------------|---------------------|----------------------------|-----------------------------|
| <b>CSTB 4020-200-30</b> | 15°                            | R1          | R200           | R3            | 8.6                     | 60                  | 6                          | 23,400                      |
| <b>CSTB 4030-250-40</b> | 20°                            | R1.5        | R250           | R4            | 8.7                     | 70                  | 8                          | 29,000                      |
| <b>CSTB 4040-250-40</b> | 20°                            | R2          | R250           | R5            | 10.7                    | 80                  | 10                         | 33,330                      |
| <b>CSTB 4060-250-45</b> | 22.5°                          | R3          | R250           | R6            | 10.7                    | 100                 | 12                         | 40,320                      |
| <b>CSTB 4020-200-85</b> | 42.5°                          | R1          | R200           | R1            | 6.4                     | 100                 | 12                         | 40,320                      |

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

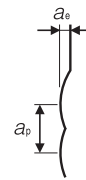
Technical Data

## Milling Conditions for CSTB

| WORK MATERIAL |            |               | ALUMINUM ALLOYS<br>A7075           |                    |                        |                         | PREHARDENED STEELS<br>PXA30(30~45HRC) |                    |                        |                         | HARDENED STEELS<br>SKD61 / STAVAX(45~55HRC) |                    |                        |                         |
|---------------|------------|---------------|------------------------------------|--------------------|------------------------|-------------------------|---------------------------------------|--------------------|------------------------|-------------------------|---|--------------------|------------------------|-------------------------|
| Model Number  | Tip R (mm) | Barrel R (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )    | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )          | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 4020-200-30   | R1         | R200          | 18,000                             | 2,400              | 2.85                   | 0.1                     | 11,500                                | 1,800              | 1.9                    | 0.075                   | 9,000                                       | 1,440              | 1.5                    | 0.075                   |
| 4030-250-40   | R1.5       | R250          | 15,600                             | 2,400              | 2.85                   | 0.1                     | 10,300                                | 1,600              | 2.4                    | 0.075                   | 8,000                                       | 1,200              | 2                      | 0.075                   |
| 4040-250-40   | R2         | R250          | 13,200                             | 2,400              | 2.85                   | 0.1                     | 9,100                                 | 1,600              | 2.4                    | 0.075                   | 7,000                                       | 1,200              | 2                      | 0.075                   |
| 4060-250-45   | R3         | R250          | 10,800                             | 2,400              | 2.85                   | 0.1                     | 8,000                                 | 1,600              | 2.4                    | 0.075                   | 6,000                                       | 1,200              | 2                      | 0.075                   |
| 4020-200-85   | R1         | R200          | 10,800                             | 1,200              | 2.85                   | 0.1                     | 8,000                                 | 700                | 2                      | 0.075                   | 6,000                                       | 500                | 2                      | 0.05                    |

**Note:**

·Set spindle speed, feed rate, and axial depth ( $a_p$ ) in accordance with the required surface quality.



4 Flutes

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



# CWTB

Super MG
UT COAT
Form ±0.01
Shank Dia 0/-0.005

**NEW**

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                | ●               | ●      |        |        |        | ○         | ●               |          | ●      |          |                       | ○               | ○                     |                  |                                       |

φ3mm Shank V Series

UDC-PDC Series

CBN Series

Square  
Long Neck Square

Radius

Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

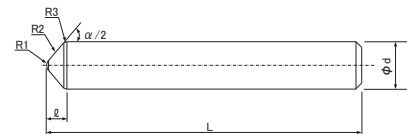
Spiral V Cutter

Drill

Technical Data

**Features**

Broad range of application available with UTCOAT.  
Suitable for finishing on flat surface with wide taper angle.



Total 2 models

Unit (mm)

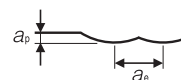
| Model Number      | Half Included Angle $\alpha/2$ | Tip R R1 | Barrel R R2 | Third R R3 | Length of Cut $\ell$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|-------------------|--------------------------------|----------|-------------|------------|----------------------|------------------|-------------------------|--------------------------|
| CWTB 4020-200-100 | 50°                            | R1       | R200        | R1         | 4.3                  | 80               | 10                      | 25,140                   |
| CWTB 4020-250-130 | 65°                            |          | R250        |            | 2.8                  | 80               | 10                      | 25,140                   |

## Milling Conditions for CWTB

| WORK MATERIAL |            |               | ALUMINUM ALLOYS<br>A7075           |                    |                        |                         | PREHARDENED STEELS<br>PXA30(30~45HRC) |                    |                        |                         | HARDENED STEELS<br>SKD61 / STAVAX(45~55HRC) |                    |                        |                         |
|---------------|------------|---------------|------------------------------------|--------------------|------------------------|-------------------------|---------------------------------------|--------------------|------------------------|-------------------------|---|--------------------|------------------------|-------------------------|
| Model Number  | Tip R (mm) | Barrel R (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )    | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> )          | Feed Rate (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| 4020-200-100  | R1         | R200          | 20,000                             | 5,000              | 0.2                    | 4                       | 12,000                                | 2,400              | 0.1                    | 4                       | 9,000                                       | 1,100              | 0.075                  | 4                       |
| 4020-250-130  |            | R250          | 20,000                             | 5,000              | 0.1                    | 2.5                     | 12,000                                | 2,400              | 0.1                    | 2.5                     | 9,000                                       | 1,100              | 0.075                  | 2.5                     |

**Note:**

·Set spindle speed, feed rate, and radial depth ( $a_e$ ) in accordance with the required surface quality.



4 Flutes

∅3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 3 \sim \phi 12$

**SV**



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

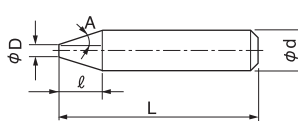
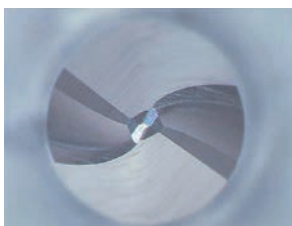
| Work Material                 |                                 |                                  |                 |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|-----------------|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC          | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ●                                |                 |        |        |        |        | ○         | ○               | ○        | ○      | ○        |                       |                 |                       |                  |                                       |

**Features**

Spiral type chamfering cutter.

Half included angle  $45^\circ$ .

By applying a spiral peripheral cutting edge, burrs are greatly reduced when compared to a straight cutting edge design.



Total 6 models

Unit (mm)

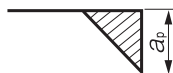
| Model Number | Tip Diameter $\phi D$ | Length of Cut $\ell$ | Overall Length L | Half Included Angle A | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|-----------------------|----------------------|------------------|-----------------------|-------------------------|--------------------------|
| SV 2030      | 0.8                   | 1.1                  | 40               | 45°                   | 3                       | 13,000                   |
| SV 2040      |                       | 1.6                  | 45               |                       | 4                       | 14,000                   |
| SV 2060      | 1                     | 2.5                  | 50               |                       | 6                       | 15,750                   |
| SV 2080      |                       | 3.5                  | 60               |                       | 8                       | 19,250                   |
| SV 2100      |                       | 4.5                  | 70               |                       | 10                      | 27,500                   |
| SV 2120      |                       | 5.5                  | 75               |                       | 12                      | 32,230                   |

## Milling Conditions for SV

| WORK MATERIAL |                        | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                       | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                       |
|---------------|------------------------|--|-----------------------|---|-----------------------|--|-----------------------|
| Model Number  | Shank Diameter<br>(mm) | Spindle Speed<br>(min <sup>-1</sup> )    | Feed Rate<br>(mm/min) | Spindle Speed<br>(min <sup>-1</sup> )         | Feed Rate<br>(mm/min) | Spindle Speed<br>(min <sup>-1</sup> )                            | Feed Rate<br>(mm/min) |
| <b>2030</b>   | <b>3</b>               | 2,700~5,300                              | 59~86                 | 2,100~4,200                                   | 46~67                 | 1,600~3,200  | 35~51                 |
| <b>2040</b>   | <b>4</b>               | 2,000~4,000                              | 48~68                 | 1,600~3,200                                   | 38~54                 | 1,200~2,400  | 29~41                 |
| <b>2060</b>   | <b>6</b>               | 1,300~2,700                              | 36~49                 | 1,100~2,100                                   | 31~42                 | 800~1,600  | 22~30                 |
| <b>2080</b>   | <b>8</b>               | 1,000~2,000                              | 32~42                 | 800~1,600                                     | 26~34                 | 600~1,200  | 22~30                 |
| <b>2100</b>   | <b>10</b>              | 800~1,600                                | 30~37                 | 640~1,300                                     | 23~29                 | 600~1,200  | 17~22                 |
| <b>2120</b>   | <b>12</b>              | 700~1,300                                | 28~35                 | 530~1,100                                     | 21~27                 | 400~800  | 17~22                 |

Milling Amount (mm)

$$a_p = 0.1D$$

 $a_p$  : Axial Depth (mm)


Note:

- The figures listed above are for nominal diameters. Adjust the speed and feed rate according to the correct diameter.
- Recommend slot milling with the tip flutes. Decrease the feed rate 50% from the milling parameters in this case.
- Recommend water soluble or oil coolant.

 Ø3mm Shank  
V Series
UDC-PCD  
SeriesCBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Taper

Barrel

Barrel

Spiral  
V Cutter

Drill

Drill

Technical Data

Technical Data



Size  $\phi 2 \sim \phi 12$

**UTDF**



Patented in Japan

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material              |                               |                                 |                                  |                 |         |         |         |         |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|----------------------------|-------------------------------|---------------------------------|----------------------------------|-----------------|---------|---------|---------|---------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Structural Steels<br>SS400 | Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels |         |         |         |         | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                            |                               |                                 |                                  | ~ 50HRC         | ~ 55HRC | ~ 60HRC | ~ 65HRC | ~ 70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                          | ●                             | ●                               | ○                                |                 |         |         |         |         | ●         | ●               |          |        |          |                       |                 |                       |                  |                                       |

$\phi 3$ mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius  
Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

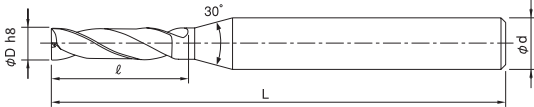
Spiral V Cutter

Drill

Technical Data

**Features**

Available to a wide variety of applications by the 180° point angle.  
 The helix angle of 30° offers excellent chip evacuation, stable and highly efficient pilot hole drilling.  
 New web-thinning design for improved chip evacuation and sharpness.  
 Double-margin will guide the tool into inner wall and achieve high-straightness drilling to non-planar surface.  
 Size M4 - M12 for drilling pilot holes before tapping.



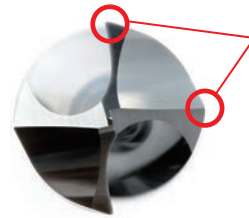
| Outside Diameter      | Diameter Tolerance(h8) |
|-----------------------|------------------------|
| $\phi D \leq 3$       | 0/-0.014               |
| $3 < \phi D \leq 6$   | 0/-0.018               |
| $6 < \phi D \leq 10$  | 0/-0.022               |
| $10 < \phi D \leq 12$ | 0/-0.027               |

**Feature1 : Helix angle 30°**



Excellent chip evacuation with 30° helix angle

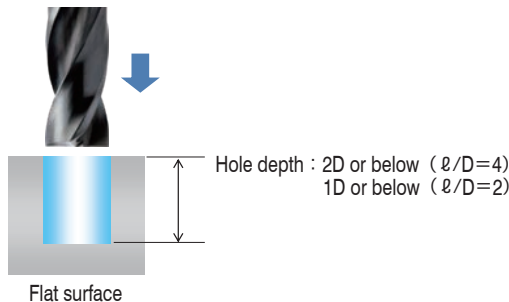
**Feature2 : Double-margin**



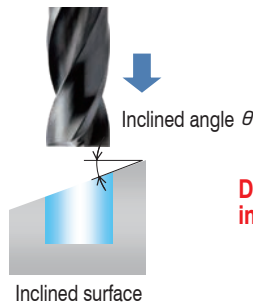
Double-margin

High-straightness drilling

**Feature3 : A wide variety of applications**



Flat surface



Inclined surface

Designed for drilling on flat, inclined or curved surfaces.



Total 21 models

Unit (mm)

| Model Number   | Diameter<br>$\phi$ D | Flute Length<br>$\ell$ | Overall Length<br>L | Shank Diameter<br>$\phi$ d | Suggested<br>Retail Price<br>¥ |
|----------------|----------------------|------------------------|---------------------|----------------------------|--------------------------------|
| UTDF 2200-080  | 2                    | 8                      | 50                  | 4                          | 6,500                          |
| UTDF 2250-100  | 2.5                  | 10                     | 50                  | 4                          | 6,500                          |
| UTDF 2300-120  | 3                    | 12                     | 60                  | 6                          | 6,500                          |
| UTDF 2330-132  | 3.3                  | 13.2                   | 60                  | 6                          | 7,000                          |
| UTDF 2400-160  | 4                    | 16                     | 60                  | 6                          | 7,200                          |
| UTDF 2420-168  | 4.2                  | 16.8                   | 60                  | 6                          | 7,500                          |
| UTDF 2500-200  | 5                    | 20                     | 60                  | 6                          | 7,800                          |
| UTDF 2510-204  | 5.1                  | 20.4                   | 60                  | 6                          | 7,800                          |
| UTDF 2600-240  | 6                    | 24                     | 60                  | 6                          | 8,000                          |
| UTDF 2650-130  | 6.5                  | 13                     | 70                  | 8                          | 9,700                          |
| UTDF 2680-272  | 6.8                  | 27.2                   | 70                  | 8                          | 9,700                          |
| UTDF 2700-280  | 7                    | 28                     | 80                  | 8                          | 9,700                          |
| UTDF 2800-320  | 8                    | 32                     | 80                  | 8                          | 10,500                         |
| UTDF 2850-340  | 8.5                  | 34                     | 80                  | 10                         | 11,500                         |
| UTDF 2860-344  | 8.6                  | 34.4                   | 80                  | 10                         | 11,500                         |
| UTDF 2900-360  | 9                    | 36                     | 80                  | 10                         | 13,500                         |
| UTDF 2950-190  | 9.5                  | 19                     | 90                  | 10                         | 13,500                         |
| UTDF 21000-400 | 10                   | 40                     | 90                  | 10                         | 13,500                         |
| UTDF 21030-412 | 10.3                 | 41.2                   | 90                  | 12                         | 14,000                         |
| UTDF 21100-220 | 11                   | 22                     | 100                 | 12                         | 15,500                         |
| UTDF 21200-480 | 12                   | 48                     | 100                 | 12                         | 15,500                         |

\*Contact our sales for the custom size tool.

$\phi$ 3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Drilling Conditions for UTDF

Flat Surface

| WORK MATERIAL          |                        |                         | CARBON STEELS<br>STRUCTURAL STEELS<br>GRAY CAST IRON<br>S50C / SS400 / FC250 | ALLOY STEELS<br>SCM415 | PREHARDENED<br>STEELS<br>NAK80     | DUCTILE IRON<br>FCD | ALUMINUM<br>ALLOYS<br>A5052 / A7075 | ALUMINUM<br>CAST<br>ADC12 |                                    |                    |                                    |                    |                                    |                    |       |
|------------------------|------------------------|-------------------------|--|------------------------|------------------------------------|---------------------|-------------------------------------|---------------------------|------------------------------------|--------------------|------------------------------------|--------------------|------------------------------------|--------------------|-------|
| Model Number           | Diameter $\phi D$ (mm) | Flute Length $l_f$ (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min)     | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)  | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min)        | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) |       |
| □3mm Shank V Series    | 2200-080               | 2                       | 8  | 15,000                 | 900                                | 12,900              | 740                                 | 6,000                     | 160                                | 12,900             | 660                                | 25,200             | 2,070                              | 18,900             | 1,340 |
|                        | 2250-100               | 2.5                     | 10   | 12,000                 | 880                                | 10,320              | 730                                 | 4,800                     | 160                                | 10,320             | 660                                | 20,160             | 2,070                              | 15,120             | 1,340 |
| UDC-PCD Series         | 2300-120               | 3                       | 12   | 10,000                 | 860                                | 8,600               | 710                                 | 4,000                     | 150                                | 8,600              | 630                                | 16,800             | 1,970                              | 12,600             | 1,280 |
|                        | 2330-132               | 3.3                     | 13.2   | 9,090                  | 860                                | 7,820               | 710                                 | 3,640                     | 150                                | 7,820              | 630                                | 15,280             | 1,970                              | 11,460             | 1,280 |
| CBN Series             | 2400-160               | 4                       | 16   | 7,500                  | 830                                | 6,450               | 690                                 | 3,000                     | 150                                | 6,450              | 610                                | 12,600             | 1,900                              | 9,450              | 1,230 |
|                        | 2420-168               | 4.2                     | 16.8   | 7,150                  | 830                                | 6,150               | 690                                 | 2,860                     | 150                                | 6,150              | 610                                | 12,000             | 1,900                              | 9,000              | 1,230 |
| Square                 | 2500-200               | 5                       | 20   | 6,000                  | 800                                | 5,160               | 660                                 | 2,400                     | 140                                | 5,160              | 590                                | 10,080             | 1,840                              | 7,560              | 1,190 |
|                        | 2510-204               | 5.1                     | 20.4   | 5,880                  | 800                                | 5,060               | 660                                 | 2,350                     | 140                                | 5,060              | 590                                | 9,880              | 1,840                              | 7,400              | 1,190 |
| Long Neck Square       | 2600-240               | 6                       | 24   | 5,000                  | 770                                | 4,300               | 640                                 | 2,000                     | 140                                | 4,300              | 560                                | 8,400              | 1,770                              | 6,300              | 1,140 |
|                        | 2650-130               | 6.5                     | 13   | 4,620                  | 770                                | 3,970               | 640                                 | 1,850                     | 140                                | 3,970              | 560                                | 7,750              | 1,770                              | 5,820              | 1,140 |
| Radius                 | 2680-272               | 6.8                     | 27.2   | 4,420                  | 770                                | 3,800               | 640                                 | 1,770                     | 140                                | 3,800              | 560                                | 7,420              | 1,770                              | 5,560              | 1,140 |
|                        | 2700-280               | 7                       | 28   | 4,290                  | 760                                | 3,680               | 630                                 | 1,710                     | 140                                | 3,680              | 560                                | 7,200              | 1,770                              | 5,400              | 1,140 |
| Long Neck Radius       | 2800-320               | 8                       | 32   | 3,750                  | 730                                | 3,230               | 600                                 | 1,500                     | 130                                | 3,230              | 540                                | 6,300              | 1,670                              | 4,730              | 1,080 |
|                        | 2850-340               | 8.5                     | 34   | 3,530                  | 730                                | 3,040               | 600                                 | 1,420                     | 130                                | 3,040              | 540                                | 5,930              | 1,670                              | 4,450              | 1,080 |
| Taper Neck Radius      | 2860-344               | 8.6                     | 34.4   | 3,490                  | 720                                | 3,000               | 600                                 | 1,400                     | 130                                | 3,000              | 540                                | 5,860              | 1,670                              | 4,400              | 1,080 |
|                        | 2900-360               | 9                       | 36   | 3,330                  | 720                                | 2,870               | 590                                 | 1,330                     | 120                                | 2,870              | 530                                | 5,600              | 1,670                              | 4,200              | 1,080 |
| Ball / Long Shank Ball | 2950-190               | 9.5                     | 19   | 3,160                  | 700                                | 2,720               | 580                                 | 1,260                     | 120                                | 2,720              | 520                                | 5,300              | 1,620                              | 3,980              | 1,050 |
|                        | 21000-400              | 10                      | 40   | 3,000                  | 690                                | 2,580               | 570                                 | 1,200                     | 120                                | 2,580              | 510                                | 5,040              | 1,580                              | 3,780              | 1,020 |
| Long Neck Ball         | 21030-412              | 10.3                    | 41.2   | 2,920                  | 690                                | 2,510               | 570                                 | 1,170                     | 120                                | 2,510              | 510                                | 4,900              | 1,580                              | 3,670              | 1,020 |
|                        | 21100-220              | 11                      | 22   | 2,730                  | 670                                | 2,350               | 550                                 | 1,090                     | 110                                | 2,350              | 500                                | 4,580              | 1,540                              | 3,440              | 1,000 |
| Taper Neck Ball        | 21200-480              | 12                      | 48   | 2,500                  | 650                                | 2,150               | 540                                 | 1,000                     | 110                                | 2,150              | 480                                | 4,200              | 1,490                              | 3,150              | 960   |

□3mm Shank V Series

UDC-PCD Series

CBN Series

Square  
Long Neck Square

Radius

Radius  
Long Neck Radius  
Taper Neck Radius

Ball / Long Shank Ball

Ball  
Long Neck Ball  
Taper Neck Ball

Taper

Barrel

Spiral V Cutter

Drill

Technical Data

## Drilling Conditions for UTDF

Inclined Surface ( $\theta \leq 30^\circ$ )

| WORK MATERIAL   |                              |                             | CARBON STEELS<br>STRUCTURAL STEELS<br>GRAY CAST IRON<br>S50C / SS400 / FC250 |                          | ALLOY STEELS<br>SCM415                   |                          | PREHARDENED<br>STEELS<br>NAK80           |                          | DUCTILE IRON<br>FCD                      |                          | ALUMINUM<br>ALLOYS<br>A5052 / A7075      |                          | ALUMINUM<br>CAST<br>ADC12                |                          |
|-----------------|------------------------------|-----------------------------|--|--------------------------|--|--------------------------|--|--------------------------|--|--------------------------|--|--------------------------|--|--------------------------|
| Model<br>Number | Diameter<br>$\phi$ D<br>(mm) | Flute<br>Length $l$<br>(mm) | Spindle<br>Speed<br>(min <sup>-1</sup> )                                     | Feed<br>Rate<br>(mm/min) | Spindle<br>Speed<br>(min <sup>-1</sup> ) | Feed<br>Rate<br>(mm/min) | Spindle<br>Speed<br>(min <sup>-1</sup> ) | Feed<br>Rate<br>(mm/min) | Spindle<br>Speed<br>(min <sup>-1</sup> ) | Feed<br>Rate<br>(mm/min) | Spindle<br>Speed<br>(min <sup>-1</sup> ) | Feed<br>Rate<br>(mm/min) | Spindle<br>Speed<br>(min <sup>-1</sup> ) | Feed<br>Rate<br>(mm/min) |
| 2200-080        | 2                            | 8                           | 15,000   | 270                      | 12,900                                   | 220                      | 6,000                                    | 48                       | 12,900                                   | 190                      | 25,200                                   | 620                      | 18,900                                   | 400                      |
| 2250-100        | 2.5                          | 10                          | 12,000   | 260                      | 10,320                                   | 220                      | 4,800                                    | 48                       | 10,320                                   | 190                      | 20,160                                   | 620                      | 15,120                                   | 400                      |
| 2300-120        | 3                            | 12                          | 10,000   | 250                      | 8,600                                    | 210                      | 4,000                                    | 45                       | 8,600                                    | 180                      | 16,800                                   | 590                      | 12,600                                   | 380                      |
| 2330-132        | 3.3                          | 13.2                        | 9,090  | 250                      | 7,820                                    | 210                      | 3,640                                    | 45                       | 7,820                                    | 180                      | 15,280                                   | 590                      | 11,460                                   | 380                      |
| 2400-160        | 4                            | 16                          | 7,500  | 240                      | 6,450                                    | 200                      | 3,000                                    | 45                       | 6,450                                    | 180                      | 12,600                                   | 570                      | 9,450                                    | 360                      |
| 2420-168        | 4.2                          | 16.8                        | 7,150  | 240                      | 6,150                                    | 200                      | 2,860                                    | 45                       | 6,150                                    | 180                      | 12,000                                   | 570                      | 9,000                                    | 360                      |
| 2500-200        | 5                            | 20                          | 6,000  | 240                      | 5,160                                    | 190                      | 2,400                                    | 42                       | 5,160                                    | 170                      | 10,080                                   | 550                      | 7,560                                    | 350                      |
| 2510-204        | 5.1                          | 20.4                        | 5,880  | 230                      | 5,060                                    | 190                      | 2,350                                    | 42                       | 5,060                                    | 170                      | 9,880                                    | 550                      | 7,400                                    | 350                      |
| 2600-240        | 6                            | 24                          | 5,000  | 230                      | 4,300                                    | 190                      | 2,000                                    | 42                       | 4,300                                    | 160                      | 8,400                                    | 530                      | 6,300                                    | 340                      |
| 2650-130        | 6.5                          | 13                          | 4,620  | 230                      | 3,970                                    | 190                      | 1,850                                    | 42                       | 3,970                                    | 160                      | 7,750                                    | 530                      | 5,820                                    | 340                      |
| 2680-272        | 6.8                          | 27.2                        | 4,420  | 230                      | 3,800                                    | 190                      | 1,770                                    | 42                       | 3,800                                    | 160                      | 7,420                                    | 530                      | 5,560                                    | 340                      |
| 2700-280        | 7                            | 28                          | 4,290  | 230                      | 3,680                                    | 190                      | 1,710                                    | 42                       | 3,680                                    | 160                      | 7,200                                    | 530                      | 5,400                                    | 340                      |
| 2800-320        | 8                            | 32                          | 3,750  | 210                      | 3,230                                    | 180                      | 1,500                                    | 39                       | 3,230                                    | 160                      | 6,300                                    | 500                      | 4,730                                    | 320                      |
| 2850-340        | 8.5                          | 34                          | 3,530  | 210                      | 3,040                                    | 180                      | 1,420                                    | 39                       | 3,040                                    | 160                      | 5,930                                    | 500                      | 4,450                                    | 320                      |
| 2860-344        | 8.6                          | 34.4                        | 3,490  | 210                      | 3,000                                    | 180                      | 1,400                                    | 39                       | 3,000                                    | 160                      | 5,860                                    | 500                      | 4,400                                    | 320                      |
| 2900-360        | 9                            | 36                          | 3,330  | 210                      | 2,870                                    | 180                      | 1,330                                    | 38                       | 2,870                                    | 160                      | 5,600                                    | 500                      | 4,200                                    | 320                      |
| 2950-190        | 9.5                          | 19                          | 3,160  | 210                      | 2,720                                    | 170                      | 1,260                                    | 36                       | 2,720                                    | 150                      | 5,300                                    | 490                      | 3,980                                    | 310                      |
| 21000-400       | 10                           | 40                          | 3,000  | 200                      | 2,580                                    | 170                      | 1,200                                    | 36                       | 2,580                                    | 150                      | 5,040                                    | 470                      | 3,780                                    | 300                      |
| 21030-412       | 10.3                         | 41.2                        | 2,920  | 200                      | 2,510                                    | 170                      | 1,170                                    | 36                       | 2,510                                    | 150                      | 4,900                                    | 470                      | 3,670                                    | 300                      |
| 21100-220       | 11                           | 22                          | 2,730  | 200                      | 2,350                                    | 160                      | 1,090                                    | 34                       | 2,350                                    | 140                      | 4,580                                    | 460                      | 3,440                                    | 290                      |
| 21200-480       | 12                           | 48                          | 2,500  | 190                      | 2,150                                    | 160                      | 1,000                                    | 33                       | 2,150                                    | 140                      | 4,200                                    | 440                      | 3,150                                    | 280                      |

$\phi$ 3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

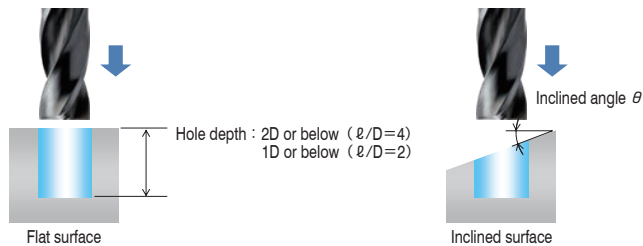
Drill

Technical Data

Drilling Conditions for UTDF

Inclined Surface ( $\theta > 30^\circ$ )

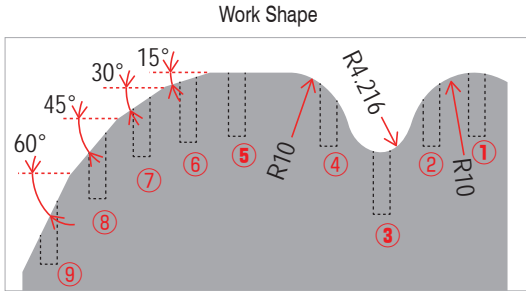
| WORK MATERIAL |                        |                          | CARBON STEELS<br>STRUCTURAL STEELS<br>GRAY CAST IRON<br>S50C / SS400 / FC250 | ALLOY STEELS<br>SCM415 | PREHARDENED<br>STEELS<br>NAK80     | DUCTILE IRON<br>FCD | ALUMINUM<br>ALLOYS<br>A5052 / A7075 | ALUMINUM<br>CAST<br>ADC12 |                                    |                    |                                    |                    |                                    |                    |
|---------------|------------------------|--------------------------|--|------------------------|------------------------------------|---------------------|-------------------------------------|---------------------------|------------------------------------|--------------------|------------------------------------|--------------------|------------------------------------|--------------------|
| Model Number  | Diameter $\phi D$ (mm) | Flute Length $\ell$ (mm) | Spindle Speed (min <sup>-1</sup> )   | Feed Rate (mm/min)     | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min)  | Spindle Speed (min <sup>-1</sup> )  | Feed Rate (mm/min)        | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) |
| 2200-080      | 2                      | 8                        | 10,500   | 90                     | 9,030                              | 74                  | 4,200                               | 16                        | 9,030                              | 66                 | 17,640                             | 200                | 13,230                             | 130                |
| 2250-100      | 2.5                    | 10                       | 8,400  | 90                     | 7,220                              | 74                  | 3,360                               | 16                        | 7,220                              | 66                 | 14,110                             | 200                | 10,580                             | 130                |
| 2300-120      | 3                      | 12                       | 7,000  | 86                     | 6,020                              | 71                  | 2,800                               | 15                        | 6,020                              | 63                 | 11,760                             | 190                | 8,820                              | 120                |
| 2330-132      | 3.3                    | 13.2                     | 6,370  | 86                     | 5,480                              | 71                  | 2,550                               | 15                        | 5,480                              | 63                 | 10,700                             | 190                | 8,030                              | 120                |
| 2400-160      | 4                      | 16                       | 5,250  | 83                     | 4,520                              | 69                  | 2,100                               | 15                        | 4,520                              | 61                 | 8,820                              | 190                | 6,620                              | 120                |
| 2420-168      | 4.2                    | 16.8                     | 5,010  | 83                     | 4,310                              | 69                  | 2,010                               | 15                        | 4,310                              | 61                 | 8,400                              | 190                | 6,300                              | 120                |
| 2500-200      | 5                      | 20                       | 4,200  | 80                     | 3,620                              | 66                  | 1,680                               | 14                        | 3,620                              | 59                 | 7,060                              | 180                | 5,300                              | 110                |
| 2510-204      | 5.1                    | 20.4                     | 4,120  | 80                     | 3,540                              | 66                  | 1,650                               | 14                        | 3,540                              | 59                 | 6,920                              | 180                | 5,190                              | 110                |
| 2600-240      | 6                      | 24                       | 3,500  | 77                     | 3,010                              | 64                  | 1,400                               | 14                        | 3,010                              | 56                 | 5,880                              | 170                | 4,410                              | 110                |
| 2650-130      | 6.5                    | 13                       | 3,230  | 77                     | 2,780                              | 64                  | 1,290                               | 14                        | 2,780                              | 56                 | 5,430                              | 170                | 4,070                              | 110                |
| 2680-272      | 6.8                    | 27.2                     | 3,100  | 77                     | 2,660                              | 64                  | 1,240                               | 14                        | 2,660                              | 56                 | 5,200                              | 170                | 3,900                              | 110                |
| 2700-280      | 7                      | 28                       | 3,000  | 77                     | 2,580                              | 64                  | 1,200                               | 14                        | 2,580                              | 56                 | 5,040                              | 170                | 3,780                              | 110                |
| 2800-320      | 8                      | 32                       | 2,630  | 73                     | 2,270                              | 60                  | 1,050                               | 13                        | 2,270                              | 54                 | 4,410                              | 160                | 3,320                              | 100                |
| 2850-340      | 8.5                    | 34                       | 2,480  | 73                     | 2,130                              | 60                  | 1,000                               | 13                        | 2,130                              | 54                 | 4,160                              | 160                | 3,120                              | 100                |
| 2860-344      | 8.6                    | 34.4                     | 2,440  | 73                     | 2,100                              | 60                  | 980                                 | 13                        | 2,100                              | 54                 | 4,100                              | 160                | 3,080                              | 100                |
| 2900-360      | 9                      | 36                       | 2,330  | 73                     | 2,010                              | 60                  | 930                                 | 13                        | 2,010                              | 54                 | 3,920                              | 160                | 2,940                              | 100                |
| 2950-190      | 9.5                    | 19                       | 2,210  | 71                     | 1,900                              | 58                  | 880                                 | 12                        | 1,900                              | 53                 | 3,710                              | 150                | 2,790                              | 100                |
| 21000-400     | 10                     | 40                       | 2,100  | 69                     | 1,810                              | 57                  | 840                                 | 12                        | 1,810                              | 51                 | 3,530                              | 150                | 2,650                              | 100                |
| 21030-412     | 10.3                   | 41.2                     | 2,050  | 69                     | 1,760                              | 57                  | 820                                 | 12                        | 1,760                              | 51                 | 3,430                              | 150                | 2,570                              | 100                |
| 21100-220     | 11                     | 22                       | 1,910  | 67                     | 1,640                              | 55                  | 760                                 | 11                        | 1,640                              | 49                 | 3,210                              | 140                | 2,400                              | 90                 |
| 21200-480     | 12                     | 48                       | 1,750  | 65                     | 1,510                              | 54                  | 700                                 | 11                        | 1,510                              | 48                 | 2,940                              | 140                | 2,210                              | 90                 |



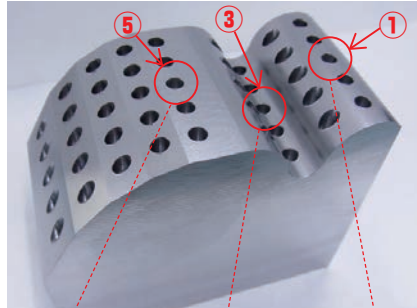
Note:

- These milling parameters are for reference only.
- Adjust the parameters in accordance with the machine rigidity, workpiece clamping condition and shape.
- Recommend water soluble or oil coolant.
- Step milling is recommended in case of clogging.

**UTDF Inclined Surface Drilling Example** **SS400**  
 $\phi 3.5 \times$  Flute Length 14 mm (Prototype)



Coolant : Water Soluble (Nozzle)  
 Work Size : 40 × 75 × 60 mm



Each hole after drilling  
**Excellent drilling performance with less burrs.**

| Drilling spot | Surface                | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (min/min) | Drilling Depth (The Deepest spot) (mm) |
|---------------|------------------------|------------------------------------|---------------------|--|
| 1             | ☐ Curved surface (Top) | 7,000                              | 450                 | 7                                      |
| 2             | Curved surface (45°)   |                                    | 270                 |  |
| 3             | ☐ Curved surface (Top) |                                    | 450                 |  |
| 4             | Curved surface (45°)   |                                    | 270                 |  |
| 5             | Flat Surface           |                                    | 450                 |  |
| 6             | Inclined Surface (15°) |                                    | 320                 |  |
| 7             | Inclined Surface (30°) |                                    | 320                 |  |
| 8             | Inclined Surface (45°) |                                    | 270                 |  |
| 9             | Inclined Surface (60°) |                                    | 225                 |  |

\*Contact our sales for the custom size tool.

UTDF  
 Inclined Surface  
 Drilling Video



**Tool After Drilling  $\phi 2 \times$  Flute Length 8 mm** **A5052**

| Surface      | Spindle Speed            | Feed Rate  | Drilling Depth | Number of Holes | Coolant                |
|--------------|--------------------------|------------|----------------|-----------------|------------------------|
| Flat Surface | 23,100 min <sup>-1</sup> | 830 mm/min | 4 mm           | 100 holes       | Water Soluble (Nozzle) |

Comparison of Tip Damage after 100 hits

**UTDF**



**Competitor**



**More tool-life left without adhesion after drilling 100 holes.**

Chip adhesion

- ☐3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Size  $\phi 0.3 \sim \phi 2$

# UTDSX



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material              |                               |                                 |                                  |   |         |         |         |         |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|----------------------------|-------------------------------|---------------------------------|----------------------------------|---|---------|---------|---------|---------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Structural Steels<br>SS400 | Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels                         |         |         |         |         | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                            |                               |                                 |                                  | ~ 50HRC                                 | ~ 55HRC | ~ 60HRC | ~ 65HRC | ~ 70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                          | ●                             | ●                               | ○                                | Contact sales when drilling over 45HRC. |         |         |         |         | ○         | ●               |          | ○      |          |                       |                 | ○                     | ○                |                                       |

Total 35 models

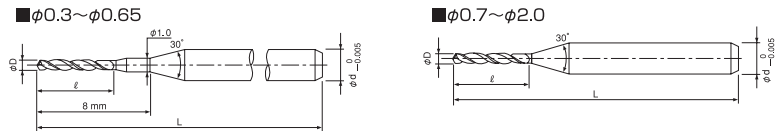
Unit (mm)

| Model Number   | Diameter $\phi D$ | Flute Length $\ell$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-------------------|---------------------|------------------|-------------------------|--------------------------|
| UTDSX 2030-015 | 0.3               | 1.5                 | 38               | 3                       | 3,470                    |
| UTDSX 2035-018 | 0.35              | 1.8                 | 38               | 3                       | 3,860                    |
| UTDSX 2040-020 | 0.4               | 2                   | 38               | 3                       | 3,470                    |
| UTDSX 2045-023 | 0.45              | 2.3                 | 38               | 3                       | 3,860                    |
| UTDSX 2050-025 | 0.5               | 2.5                 | 38               | 3                       | 3,860                    |
| UTDSX 2055-028 | 0.55              | 2.8                 | 38               | 3                       | 3,070                    |
| UTDSX 2060-030 | 0.6               | 3                   | 38               | 3                       | 2,670                    |
| UTDSX 2065-033 | 0.65              | 3.3                 | 38               | 3                       | 3,070                    |
| UTDSX 2070-035 | 0.7               | 3.5                 | 38               | 3                       | 2,670                    |
| UTDSX 2075-038 | 0.75              | 3.8                 | 38               | 3                       | 3,070                    |
| UTDSX 2080-040 | 0.8               | 4                   | 38               | 3                       | 2,670                    |
| UTDSX 2085-043 | 0.85              | 4.3                 | 38               | 3                       | 3,070                    |
| UTDSX 2090-045 | 0.9               | 4.5                 | 38               | 3                       | 2,670                    |
| UTDSX 2095-048 | 0.95              | 4.8                 | 38               | 3                       | 3,070                    |
| UTDSX 2100-050 | 1                 | 5                   | 38               | 3                       | 2,480                    |
| UTDSX 2105-053 | 1.05              | 5.3                 | 38               | 3                       | 2,480                    |
| UTDSX 2110-055 | 1.1               | 5.5                 | 38               | 3                       | 2,480                    |
| UTDSX 2115-058 | 1.15              | 5.8                 | 38               | 3                       | 2,480                    |
| UTDSX 2120-060 | 1.2               | 6                   | 38               | 3                       | 2,480                    |
| UTDSX 2125-063 | 1.25              | 6.3                 | 38               | 3                       | 2,480                    |
| UTDSX 2130-065 | 1.3               | 6.5                 | 38               | 3                       | 2,480                    |
| UTDSX 2135-068 | 1.35              | 6.8                 | 38               | 3                       | 2,480                    |
| UTDSX 2140-070 | 1.4               | 7                   | 38               | 3                       | 2,480                    |
| UTDSX 2145-073 | 1.45              | 7.3                 | 38               | 3                       | 2,480                    |
| UTDSX 2150-075 | 1.5               | 7.5                 | 38               | 3                       | 2,480                    |
| UTDSX 2155-078 | 1.55              | 7.8                 | 38               | 3                       | 2,480                    |
| UTDSX 2160-080 | 1.6               | 8                   | 38               | 3                       | 2,480                    |
| UTDSX 2165-083 | 1.65              | 8.3                 | 38               | 3                       | 2,670                    |
| UTDSX 2170-085 | 1.7               | 8.5                 | 38               | 3                       | 2,670                    |
| UTDSX 2175-088 | 1.75              | 8.8                 | 38               | 3                       | 2,670                    |
| UTDSX 2180-090 | 1.8               | 9                   | 38               | 3                       | 2,670                    |
| UTDSX 2185-093 | 1.85              | 9.3                 | 38               | 3                       | 2,670                    |
| UTDSX 2190-095 | 1.9               | 9.5                 | 38               | 3                       | 2,670                    |
| UTDSX 2195-098 | 1.95              | 9.8                 | 38               | 3                       | 2,670                    |
| UTDSX 2200-100 | 2                 | 10                  | 38               | 3                       | 2,670                    |

## Features

A highly efficient and economic drill for both mass and prototype production of parts.  
 UT MICRO COAT offers excellent performance for cutting soft materials.  
 The new drill design and X thinning offer stable drilling performance with increased tool life.  
 The 130° point angle ensures reduced burring of the drilled hole.  
 The high rigidity short flute is perfect for high accuracy drilling and pilot hole drilling.

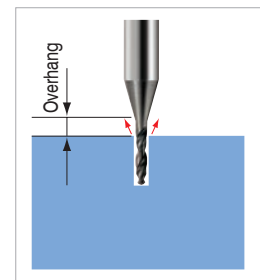
Diameter Tolerance: 0/-0.01 mm  
 Point Angle: 130°



## Drilling Conditions for UTDSX

| WORK MATERIAL | STRUCTURAL STEELS<br>SS400         |                    | CARBON STEELS<br>S50C              |                    | ALLOY STEELS<br>SCM / SUS          |                    | ALUMINUM ALLOYS<br>A5052 / ADC12   |                    |
|---------------|------------------------------------|--------------------|------------------------------------|--------------------|------------------------------------|--------------------|------------------------------------|--------------------|
| Velocity      | Vc=20~35 m/min                     |                    | Vc=20~35 m/min                     |                    | Vc=15~20 m/min                     |                    | Vc=20~60 m/min                     |                    |
| Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) |
| 0.3           | 20,000                             | 100                | 20,000                             | 100                | 16,000                             | 80                 | 20,000                             | 200                |
| 0.4           | 17,400                             | 130                | 17,400                             | 180                | 12,000                             | 90                 | 20,000                             | 440                |
| 0.5           | 15,900                             | 150                | 15,900                             | 250                | 9,500                              | 100                | 20,000                             | 680                |
| 0.6           | 14,100                             | 170                | 14,100                             | 300                | 8,000                              | 110                | 20,000                             | 920                |
| 0.7           | 12,800                             | 180                | 12,800                             | 340                | 6,700                              | 110                | 20,000                             | 1,160              |
| 0.8           | 11,900                             | 200                | 11,900                             | 380                | 6,300                              | 120                | 20,000                             | 1,400              |
| 0.9           | 10,500                             | 200                | 10,500                             | 390                | 6,000                              | 130                | 17,500                             | 1,430              |
| 1             | 9,500                              | 200                | 9,500                              | 400                | 6,000                              | 150                | 16,000                             | 1,500              |
| 1.5           | 7,300                              | 220                | 7,300                              | 500                | 4,500                              | 180                | 13,000                             | 1,960              |
| 2             | 5,600                              | 230                | 5,600                              | 560                | 3,000                              | 160                | 9,500                              | 2,030              |
| Peck Amount   | 0.3D                               |                    | 0.5D                               |                    | 0.3D                               |                    | 1.0D                               |                    |

- Note:
- Recommend shallower drilling than flute length (under  $\phi$  1:1D,  $\phi$  1 and over: 0.5D).
  - Recommend water soluble or oil coolant.
  - Recommend oil coolant for Titanium Alloys and Heat Resistant Alloys.



φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

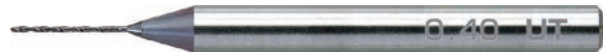
Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



Size  $\phi 0.1 \sim \phi 3$

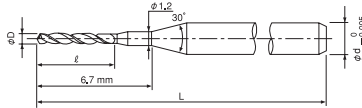
# C-UMD



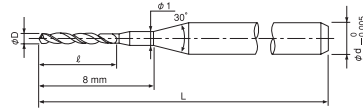
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material                 |                                 |                                  |   |        |        |        |        |           |                 |          |        |          |                       |                 |                       |                  |                                       |
|-------------------------------|---------------------------------|----------------------------------|---|--------|--------|--------|--------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|
| Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels                         |        |        |        |        | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |
|                               |                                 |                                  | ~50HRC                                  | ~55HRC | ~60HRC | ~65HRC | ~70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |
| ●                             | ●                               | ○                                | Contact sales when drilling over 45HRC. |        |        |        |        | ○         | ●               |          | ○      |          |                       | ○               | ○                     |                  |                                       |

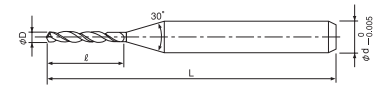
■  $\phi 0.1 \sim \phi 0.25$



■  $\phi 0.26 \sim \phi 0.65$



■  $\phi 0.66 \sim \phi 3$



Actual tool geometries for some specifications and tolerances may differ from above drawings.  $\phi 3$  is Straight type.

Diameter Tolerance :  $\phi D \leq \phi 3$  :  $\phi D -0.005$   
Point Angle :  $150^\circ$

Total 225 models

Unit (mm)

| Model Number   | Diameter $\phi D$ | Flute Length $\ell$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-------------------|---------------------|------------------|-------------------------|--------------------------|
| C-UMD 2010-012 | 0.1               | 1.2                 | 38               | 3                       | 5,500                    |
| C-UMD 2011-012 | 0.11              | 1.2                 | 38               | 3                       | 6,050                    |
| C-UMD 2012-014 | 0.12              | 1.4                 | 38               | 3                       | 6,050                    |
| C-UMD 2013-014 | 0.13              | 1.4                 | 38               | 3                       | 6,050                    |
| C-UMD 2014-014 | 0.14              | 1.4                 | 38               | 3                       | 6,050                    |
| C-UMD 2015-020 | 0.15              | 2                   | 38               | 3                       | 5,060                    |
| C-UMD 2016-020 | 0.16              | 2                   | 38               | 3                       | 5,390                    |
| C-UMD 2017-020 | 0.17              | 2                   | 38               | 3                       | 5,390                    |
| C-UMD 2018-020 | 0.18              | 2                   | 38               | 3                       | 5,390                    |
| C-UMD 2019-020 | 0.19              | 2                   | 38               | 3                       | 5,390                    |
| C-UMD 2020-025 | 0.2               | 2.5                 | 38               | 3                       | 4,400                    |
| C-UMD 2021-025 | 0.21              | 2.5                 | 38               | 3                       | 4,950                    |
| C-UMD 2022-025 | 0.22              | 2.5                 | 38               | 3                       | 4,950                    |
| C-UMD 2023-025 | 0.23              | 2.5                 | 38               | 3                       | 4,950                    |
| C-UMD 2024-025 | 0.24              | 2.5                 | 38               | 3                       | 4,950                    |
| C-UMD 2025-030 | 0.25              | 3                   | 38               | 3                       | 4,950                    |
| C-UMD 2026-030 | 0.26              | 3                   | 38               | 3                       | 4,730                    |
| C-UMD 2027-030 | 0.27              | 3                   | 38               | 3                       | 4,730                    |
| C-UMD 2028-030 | 0.28              | 3                   | 38               | 3                       | 4,730                    |
| C-UMD 2029-030 | 0.29              | 3                   | 38               | 3                       | 4,730                    |
| C-UMD 2030-050 | 0.3               | 5                   | 38               | 3                       | 3,850                    |
| C-UMD 2031-050 | 0.31              | 5                   | 38               | 3                       | 4,730                    |
| C-UMD 2032-050 | 0.32              | 5                   | 38               | 3                       | 4,730                    |
| C-UMD 2033-050 | 0.33              | 5                   | 38               | 3                       | 4,730                    |

Unit (mm)

| Model Number   | Diameter $\phi D$ | Flute Length $\ell$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-------------------|---------------------|------------------|-------------------------|--------------------------|
| C-UMD 2034-050 | 0.34              | 5                   | 38               | 3                       | 4,730                    |
| C-UMD 2035-060 | 0.35              | 6                   | 38               | 3                       | 4,290                    |
| C-UMD 2036-060 | 0.36              | 6                   | 38               | 3                       | 4,730                    |
| C-UMD 2037-060 | 0.37              | 6                   | 38               | 3                       | 4,730                    |
| C-UMD 2038-060 | 0.38              | 6                   | 38               | 3                       | 4,730                    |
| C-UMD 2039-060 | 0.39              | 6                   | 38               | 3                       | 4,730                    |
| C-UMD 2040-070 | 0.4               | 7                   | 38               | 3                       | 3,850                    |
| C-UMD 2041-070 | 0.41              | 7                   | 38               | 3                       | 4,730                    |
| C-UMD 2042-070 | 0.42              | 7                   | 38               | 3                       | 4,730                    |
| C-UMD 2043-070 | 0.43              | 7                   | 38               | 3                       | 4,730                    |
| C-UMD 2044-070 | 0.44              | 7                   | 38               | 3                       | 4,730                    |
| C-UMD 2045-070 | 0.45              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2046-070 | 0.46              | 7                   | 38               | 3                       | 4,730                    |
| C-UMD 2047-070 | 0.47              | 7                   | 38               | 3                       | 4,730                    |
| C-UMD 2048-070 | 0.48              | 7                   | 38               | 3                       | 4,730                    |
| C-UMD 2049-070 | 0.49              | 7                   | 38               | 3                       | 4,730                    |
| C-UMD 2050-070 | 0.5               | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2051-070 | 0.51              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2052-070 | 0.52              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2053-070 | 0.53              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2054-070 | 0.54              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2055-070 | 0.55              | 7                   | 38               | 3                       | 3,410                    |
| C-UMD 2056-070 | 0.56              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2057-070 | 0.57              | 7                   | 38               | 3                       | 4,290                    |

Next Page ➔



Unit (mm)

| Model Number   | Diameter $\phi D$ | Flute Length $\ell$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-------------------|---------------------|------------------|-------------------------|--------------------------|
| C-UMD 2058-070 | 0.58              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2059-070 | 0.59              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2060-070 | 0.6               | 7                   | 38               | 3                       | 2,970                    |
| C-UMD 2061-070 | 0.61              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2062-070 | 0.62              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2063-070 | 0.63              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2064-070 | 0.64              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2065-070 | 0.65              | 7                   | 38               | 3                       | 3,410                    |
| C-UMD 2066-070 | 0.66              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2067-070 | 0.67              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2068-070 | 0.68              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2069-070 | 0.69              | 7                   | 38               | 3                       | 4,290                    |
| C-UMD 2070-080 | 0.7               | 8                   | 38               | 3                       | 2,970                    |
| C-UMD 2071-080 | 0.71              | 8                   | 38               | 3                       | 4,290                    |
| C-UMD 2072-080 | 0.72              | 8                   | 38               | 3                       | 4,290                    |
| C-UMD 2073-080 | 0.73              | 8                   | 38               | 3                       | 4,290                    |
| C-UMD 2074-080 | 0.74              | 8                   | 38               | 3                       | 4,290                    |
| C-UMD 2075-080 | 0.75              | 8                   | 38               | 3                       | 3,410                    |
| C-UMD 2076-080 | 0.76              | 8                   | 38               | 3                       | 4,290                    |
| C-UMD 2077-080 | 0.77              | 8                   | 38               | 3                       | 4,290                    |
| C-UMD 2078-080 | 0.78              | 8                   | 38               | 3                       | 4,290                    |
| C-UMD 2079-080 | 0.79              | 8                   | 38               | 3                       | 4,290                    |
| C-UMD 2080-100 | 0.8               | 10                  | 38               | 3                       | 2,970                    |
| C-UMD 2081-100 | 0.81              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2082-100 | 0.82              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2083-100 | 0.83              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2084-100 | 0.84              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2085-100 | 0.85              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2086-100 | 0.86              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2087-100 | 0.87              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2088-100 | 0.88              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2089-100 | 0.89              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2090-100 | 0.9               | 10                  | 38               | 3                       | 2,970                    |
| C-UMD 2091-100 | 0.91              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2092-100 | 0.92              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2093-100 | 0.93              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2094-100 | 0.94              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2095-100 | 0.95              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2096-100 | 0.96              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2097-100 | 0.97              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2098-100 | 0.98              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2099-100 | 0.99              | 10                  | 38               | 3                       | 4,290                    |
| C-UMD 2100-100 | 1                 | 10                  | 38               | 3                       | 2,750                    |
| C-UMD 2101-100 | 1.01              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2102-100 | 1.02              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2103-100 | 1.03              | 10                  | 38               | 3                       | 3,410                    |

Unit (mm)

| Model Number   | Diameter $\phi D$ | Flute Length $\ell$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-------------------|---------------------|------------------|-------------------------|--------------------------|
| C-UMD 2104-100 | 1.04              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2105-100 | 1.05              | 10                  | 38               | 3                       | 2,750                    |
| C-UMD 2106-100 | 1.06              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2107-100 | 1.07              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2108-100 | 1.08              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2109-100 | 1.09              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2110-100 | 1.1               | 10                  | 38               | 3                       | 2,750                    |
| C-UMD 2111-100 | 1.11              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2112-100 | 1.12              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2113-100 | 1.13              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2114-100 | 1.14              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2115-100 | 1.15              | 10                  | 38               | 3                       | 2,750                    |
| C-UMD 2116-100 | 1.16              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2117-100 | 1.17              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2118-100 | 1.18              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2119-100 | 1.19              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2120-100 | 1.2               | 10                  | 38               | 3                       | 2,750                    |
| C-UMD 2121-100 | 1.21              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2122-100 | 1.22              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2123-100 | 1.23              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2124-100 | 1.24              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2125-100 | 1.25              | 10                  | 38               | 3                       | 2,750                    |
| C-UMD 2126-100 | 1.26              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2127-100 | 1.27              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2128-100 | 1.28              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2129-100 | 1.29              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2130-100 | 1.3               | 10                  | 38               | 3                       | 2,750                    |
| C-UMD 2131-100 | 1.31              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2132-100 | 1.32              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2133-100 | 1.33              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2134-100 | 1.34              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2135-100 | 1.35              | 10                  | 38               | 3                       | 2,750                    |
| C-UMD 2136-100 | 1.36              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2137-100 | 1.37              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2138-100 | 1.38              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2139-100 | 1.39              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2140-100 | 1.4               | 10                  | 38               | 3                       | 2,750                    |
| C-UMD 2141-100 | 1.41              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2142-100 | 1.42              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2143-100 | 1.43              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2144-100 | 1.44              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2145-100 | 1.45              | 10                  | 38               | 3                       | 2,750                    |
| C-UMD 2146-100 | 1.46              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2147-100 | 1.47              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2148-100 | 1.48              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2149-100 | 1.49              | 10                  | 38               | 3                       | 3,410                    |

3mm Shank  
V SeriesUDC-PCD  
SeriesCBN  
SeriesSquare  
Long Neck  
SquareRadius  
Long Neck  
RadiusTaper Neck  
RadiusBall / Long  
Shank BallLong Neck  
BallTaper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Next Page →

Unit (mm)

| Model Number   | Diameter $\phi D$ | Flute Length $\ell$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-------------------|---------------------|------------------|-------------------------|--------------------------|
| C-UMD 2150-100 | 1.5               | 10                  | 38               | 3                       | 2,750                    |
| C-UMD 2151-100 | 1.51              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2152-100 | 1.52              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2153-100 | 1.53              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2154-100 | 1.54              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2155-100 | 1.55              | 10                  | 38               | 3                       | 2,750                    |
| C-UMD 2156-100 | 1.56              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2157-100 | 1.57              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2158-100 | 1.58              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2159-100 | 1.59              | 10                  | 38               | 3                       | 3,410                    |
| C-UMD 2160-120 | 1.6               | 12                  | 38               | 3                       | 2,750                    |
| C-UMD 2161-120 | 1.61              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2162-120 | 1.62              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2163-120 | 1.63              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2164-120 | 1.64              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2165-120 | 1.65              | 12                  | 38               | 3                       | 2,970                    |
| C-UMD 2166-120 | 1.66              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2167-120 | 1.67              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2168-120 | 1.68              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2169-120 | 1.69              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2170-120 | 1.7               | 12                  | 38               | 3                       | 2,970                    |
| C-UMD 2171-120 | 1.71              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2172-120 | 1.72              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2173-120 | 1.73              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2174-120 | 1.74              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2175-120 | 1.75              | 12                  | 38               | 3                       | 2,970                    |
| C-UMD 2176-120 | 1.76              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2177-120 | 1.77              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2178-120 | 1.78              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2179-120 | 1.79              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2180-120 | 1.8               | 12                  | 38               | 3                       | 2,970                    |
| C-UMD 2181-120 | 1.81              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2182-120 | 1.82              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2183-120 | 1.83              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2184-120 | 1.84              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2185-120 | 1.85              | 12                  | 38               | 3                       | 2,970                    |
| C-UMD 2186-120 | 1.86              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2187-120 | 1.87              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2188-120 | 1.88              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2189-120 | 1.89              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2190-120 | 1.9               | 12                  | 38               | 3                       | 2,970                    |
| C-UMD 2191-120 | 1.91              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2192-120 | 1.92              | 12                  | 38               | 3                       | 3,630                    |

Unit (mm)

| Model Number   | Diameter $\phi D$ | Flute Length $\ell$ | Overall Length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-------------------|---------------------|------------------|-------------------------|--------------------------|
| C-UMD 2193-120 | 1.93              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2194-120 | 1.94              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2195-120 | 1.95              | 12                  | 38               | 3                       | 2,970                    |
| C-UMD 2196-120 | 1.96              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2197-120 | 1.97              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2198-120 | 1.98              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2199-120 | 1.99              | 12                  | 38               | 3                       | 3,630                    |
| C-UMD 2200-120 | 2                 | 12                  | 38               | 3                       | 2,970                    |
| C-UMD 2205-120 | 2.05              | 12                  | 38               | 3                       | 3,850                    |
| C-UMD 2210-120 | 2.1               | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2212-120 | 2.12              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2213-120 | 2.13              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2214-120 | 2.14              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2215-120 | 2.15              | 12                  | 38               | 3                       | 3,850                    |
| C-UMD 2220-120 | 2.2               | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2225-120 | 2.25              | 12                  | 38               | 3                       | 3,850                    |
| C-UMD 2229-120 | 2.29              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2230-120 | 2.3               | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2231-120 | 2.31              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2232-120 | 2.32              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2235-120 | 2.35              | 12                  | 38               | 3                       | 3,850                    |
| C-UMD 2239-120 | 2.39              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2240-120 | 2.4               | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2241-120 | 2.41              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2242-120 | 2.42              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2245-120 | 2.45              | 12                  | 38               | 3                       | 3,850                    |
| C-UMD 2250-120 | 2.5               | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2255-120 | 2.55              | 12                  | 38               | 3                       | 3,850                    |
| C-UMD 2256-120 | 2.56              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2257-120 | 2.57              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2260-120 | 2.6               | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2265-120 | 2.65              | 12                  | 38               | 3                       | 3,850                    |
| C-UMD 2270-120 | 2.7               | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2275-120 | 2.75              | 12                  | 38               | 3                       | 3,850                    |
| C-UMD 2277-120 | 2.77              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2278-120 | 2.78              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2279-120 | 2.79              | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2280-120 | 2.8               | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2285-120 | 2.85              | 12                  | 38               | 3                       | 3,850                    |
| C-UMD 2290-120 | 2.9               | 12                  | 38               | 3                       | 3,190                    |
| C-UMD 2295-120 | 2.95              | 12                  | 38               | 3                       | 3,850                    |
| C-UMD 2300-120 | 3                 | 12                  | 38               | 3                       | 3,190                    |

$\phi 3\text{mm}$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square  
Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## Drilling Conditions for C-UMD

| WORK MATERIAL    | CARBON STEELS<br>S45C / S50C<br>(~225HB) |                       | ALLOY STEELS<br>SK / SCM / SUS<br>(225~325HB) |                       | PREHARDENED STEELS<br>HARDENED STEELS<br>NAK / SKD<br>(30~45HRC) |                       | ALUMINUM ALLOYS<br>A5052 etc.         |                       |
|------------------|--|-----------------------|---|-----------------------|--|-----------------------|---------------------------------------|-----------------------|
| Velocity         | Vc=25~40 m/min                           |                       | Vc=15~25 m/min                                |                       | Vc=10~15 m/min   |                       | Vc=20~60 m/min                        |                       |
| Diameter<br>(mm) | Spindle Speed<br>(min <sup>-1</sup> )    | Feed Rate<br>(mm/min) | Spindle Speed<br>(min <sup>-1</sup> )         | Feed Rate<br>(mm/min) | Spindle Speed<br>(min <sup>-1</sup> )                            | Feed Rate<br>(mm/min) | Spindle Speed<br>(min <sup>-1</sup> ) | Feed Rate<br>(mm/min) |
| <b>0.3</b>       | 20,000                                   | 40                    | 15,900  | 30                    | 10,600   | 10                    | 20,000                                | 400                   |
| <b>0.4</b>       | 17,400                                   | 50                    | 11,800  | 40                    | 8,000  | 20                    | 19,900                                | 690                   |
| <b>0.5</b>       | 15,900                                   | 80                    | 9,500   | 50                    | 6,400  | 30                    | 20,000                                | 1,000                 |
| <b>0.6</b>       | 14,100                                   | 80                    | 7,900   | 40                    | 5,300  | 20                    | 19,900                                | 1,050                 |
| <b>0.7</b>       | 12,800                                   | 90                    | 6,800   | 50                    | 4,500  | 20                    | 19,900                                | 1,120                 |
| <b>0.8</b>       | 11,900                                   | 100                   | 6,000   | 50                    | 4,000  | 20                    | 19,900                                | 1,190                 |
| <b>0.9</b>       | 10,500                                   | 100                   | 6,200   | 50                    | 3,500  | 20                    | 17,600                                | 1,220                 |
| <b>1</b>         | 9,500                                    | 100                   | 6,400   | 60                    | 3,200  | 20                    | 15,900                                | 1,270                 |
| <b>2</b>         | 5,600                                    | 170                   | 3,200   | 100                   | 1,600  | 20                    | 9,500                                 | 950                   |
| <b>3</b>         | 3,700                                    | 150                   | 2,700   | 110                   | 1,600  | 20                    | 6,400                                 | 640                   |

### Note:

- Recommend step amount 0.1D-0.2D. Recommend 0.2D-0.5D for Aluminum Alloys.
- Recommend water soluble or oil coolant.
- Recommend oil coolant for Titanium Alloys and Heat Resistant Alloys.

Ø3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

Drilling Example 1

SUS304

**Comments**

● Tip Damage:

Damage by chipping can be seen on the Carbide Drill. The High-Speed Steel Drill exhibits wear on the top chisel line and corners. The High-Speed Steel Drill also has the work material adhering to it.

● Hole Position:

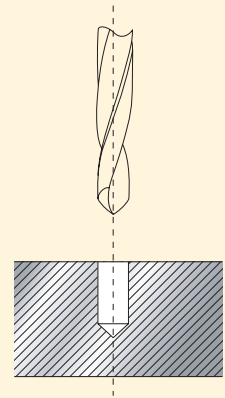
The solid carbide drill has minimal deflection when compared to a High Speed steel model, through the entire drilling cycle.

**Drilling Condition**

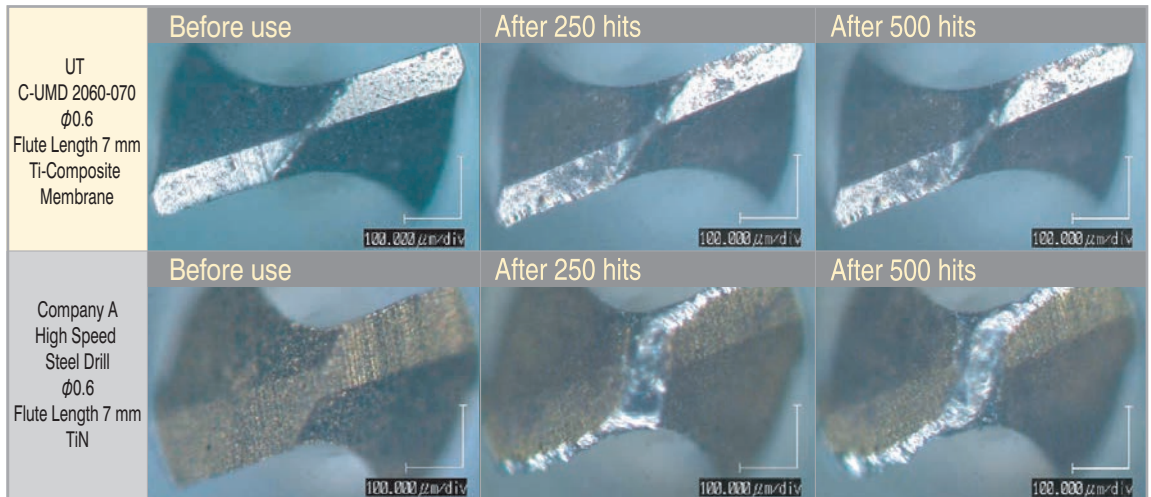
|                   |                               |
|-------------------|-------------------------------|
| Tool:             | $\phi$ 0.6 × Flute Length 7mm |
| Work Material:    | SUS304 (1.4301)               |
| Spindle Speed:    | 8,000 min <sup>-1</sup>       |
| Velocity:         | 15 m/min                      |
| Z Feed Rate:      | 50 mm/min                     |
| Chip Load:        | 0.00625 mm/rev                |
| Peck Amount:      | 0.12 mm/time                  |
| Hole Depth:       | 2.4 mm                        |
| Number of Holes:  | 500 holes                     |
| Drilling Time :   | 25 min/100 holes              |
| Overhang Length : | 10 mm                         |
| Coolant:          | Water Soluble (Nozzle)        |

**Process Form**

\* Blind Hole Step Process

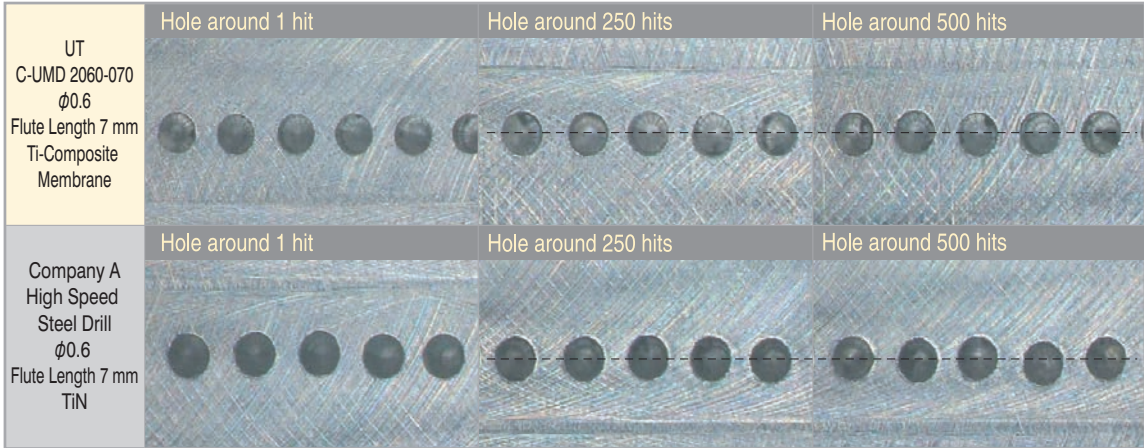


**Comparison of Tip Damage**



- $\phi$ 3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data

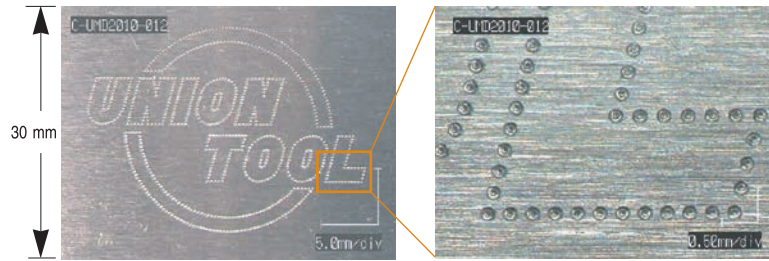
## Comparison of Hole Position



## Drilling Example 2

### SUS304

$\phi 0.1$  Drilling (about 800 holes)



|   | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Peck Amount (mm/time) | Hole Depth (mm) | Drilling Time | Coolant       | Note                        |
|---|------------------------------------|--------------------|-----------------------|-----------------|---------------|---------------|-----------------------------|
| <b>Acrylic <math>\phi 0.1</math></b>          |                                    |                    |                       |                 |               |               |                             |
| C-UMD $\phi 0.1$                              | 20,000                             | 20                 | 0.02                  | 1.00            | 1 h 30 min    | Air Blow      | Without pilot hole drilling |
| <b>SUS304 (1.4301) <math>\phi 0.1</math></b>  |                                    |                    |                       |                 |               |               |                             |
| Center Drill+Chamfering<br>C-UMD $\phi 0.2$   | 10,000                             | 2                  | 0.01                  | 0.05            | 2 h 50 min    | Water Soluble |                             |
| Drilling<br>C-UMD $\phi 0.1$                  | 12,000                             | 4                  | 0.02                  | 0.20            | 3 h 27 min    | Water Soluble |                             |
| <b>Aluminum (A5052) <math>\phi 0.2</math></b> |                                    |                    |                       |                 |               |               |                             |
| C-UMD $\phi 0.2$                              | 16,000                             | 80                 | 0.04                  | 1.50            | 2 h 50 min    | Water Soluble | Using back-up board         |
| <b>NAK55 (AISI P21) <math>\phi 0.3</math></b> |                                    |                    |                       |                 |               |               |                             |
| C-UMD $\phi 0.3$                              | 15,000                             | 15                 | 0.06                  | 1.50            | 3 h 35 min    | Water Soluble | With pilot hole drilling    |
| <b>SUS304 (1.4301) <math>\phi 0.3</math></b>  |                                    |                    |                       |                 |               |               |                             |
| C-UMD $\phi 0.3$                              | 16,000                             | 30                 | 0.06                  | 1.50            | 2 h 24 min    | Water Soluble | With pilot hole drilling    |

$\phi 3$ mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data





Size  $\phi 0.3 \sim \phi 3$

# UTDLX



Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

| Work Material              |                               |                                 |                                  |   |         |         |         |         |           |                 |          |        |          |                       |                 |                       |                  |                                       |  |
|----------------------------|-------------------------------|---------------------------------|----------------------------------|---|---------|---------|---------|---------|-----------|-----------------|----------|--------|----------|-----------------------|-----------------|-----------------------|------------------|---------------------------------------|--|
| Structural Steels<br>SS400 | Carbon Steels<br>S45C<br>S55C | Alloy Steels<br>SK / SCM<br>SUS | Prehardened Steels<br>NAK<br>HPM | Hardened Steels                         |         |         |         |         | Cast Iron | Aluminum Alloys | Graphite | Copper | Plastics | Glass Filled Plastics | Titanium Alloys | Heat Resistant Alloys | Cemented Carbide | Hard Brittle (Non-Metallic) Materials |  |
|                            |                               |                                 |                                  | ~ 50HRC                                 | ~ 55HRC | ~ 60HRC | ~ 65HRC | ~ 70HRC |           |                 |          |        |          |                       |                 |                       |                  |                                       |  |
| ●                          | ●                             | ●                               | ○                                | Contact sales when drilling over 45HRC. |         |         |         |         | ○         | ●               |          | ○      |          |                       |                 | ○                     | ○                |                                       |  |

### Features

A highly efficient and economic drill for both mass and prototype production of parts.

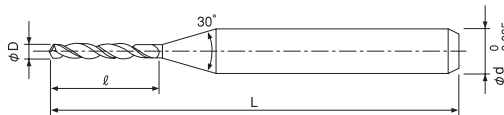
UT MICRO COAT offers excellent performance for cutting soft materials.

The new drill design and X thinning offer stable drilling performance with increased tool life.

The 130° point angle ensures reduced burring of the drilled hole.

With an aspect ratio of 15:1, the drill is ideal for deep hole drilling, that requires high accuracy.

Diameter Tolerance: 0/-0.01 mm  
Point Angle: 130°



Total 55 models

Unit (mm)

| Model Number   | Diameter $\phi D$ | Flute Length $l$ | Overall Length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|----------------|-------------------|------------------|--------------------|-------------------------|--------------------------|
| UTDLX 2030-045 | 0.3               | 4.5              | 38                 | 3                       | 4,600                    |
| UTDLX 2035-053 | 0.35              | 5.3              | 38                 | 3                       | 5,130                    |
| UTDLX 2040-060 | 0.4               | 6                | 38                 | 3                       | 4,600                    |
| UTDLX 2045-068 | 0.45              | 6.8              | 38                 | 3                       | 5,130                    |
| UTDLX 2050-075 | 0.5               | 7.5              | 38                 | 3                       | 4,600                    |
| UTDLX 2055-083 | 0.55              | 8.3              | 38                 | 3                       | 5,130                    |
| UTDLX 2060-090 | 0.6               | 9                | 45                 | 3                       | 4,600                    |
| UTDLX 2065-098 | 0.65              | 9.8              | 45                 | 3                       | 5,290                    |
| UTDLX 2070-105 | 0.7               | 10.5             | 45                 | 3                       | 4,600                    |
| UTDLX 2075-113 | 0.75              | 11.3             | 45                 | 3                       | 5,290                    |
| UTDLX 2080-120 | 0.8               | 12               | 45                 | 3                       | 4,600                    |
| UTDLX 2085-128 | 0.85              | 12.8             | 45                 | 3                       | 5,290                    |

Next Page ➔

Unit (mm)

| Model Number   | Diameter<br>$\phi$ D | Flute Length<br>$\ell$ | Overall Length<br>L | Shank Diameter<br>$\phi$ d | Suggested<br>Retail Price<br>¥ |
|----------------|----------------------|------------------------|---------------------|----------------------------|--------------------------------|
| UTDLX 2090-135 | 0.9                  | 13.5                   | 45                  | 3                          | 4,600                          |
| UTDLX 2095-143 | 0.95                 | 14.3                   | 45                  | 3                          | 5,290                          |
| UTDLX 2100-150 | 1                    | 15                     | 50                  | 3                          | 4,600                          |
| UTDLX 2105-158 | 1.05                 | 15.8                   | 50                  | 3                          | 4,600                          |
| UTDLX 2110-165 | 1.1                  | 16.5                   | 50                  | 3                          | 4,600                          |
| UTDLX 2115-173 | 1.15                 | 17.3                   | 50                  | 3                          | 4,600                          |
| UTDLX 2120-180 | 1.2                  | 18                     | 50                  | 3                          | 4,600                          |
| UTDLX 2125-188 | 1.25                 | 18.8                   | 50                  | 3                          | 4,600                          |
| UTDLX 2130-195 | 1.3                  | 19.5                   | 50                  | 3                          | 4,600                          |
| UTDLX 2135-203 | 1.35                 | 20.3                   | 60                  | 3                          | 4,600                          |
| UTDLX 2140-210 | 1.4                  | 21                     | 60                  | 3                          | 4,600                          |
| UTDLX 2145-218 | 1.45                 | 21.8                   | 60                  | 3                          | 4,600                          |
| UTDLX 2150-225 | 1.5                  | 22.5                   | 60                  | 3                          | 4,600                          |
| UTDLX 2155-233 | 1.55                 | 23.3                   | 60                  | 3                          | 4,600                          |
| UTDLX 2160-240 | 1.6                  | 24                     | 60                  | 3                          | 4,600                          |
| UTDLX 2165-248 | 1.65                 | 24.8                   | 60                  | 3                          | 4,970                          |
| UTDLX 2170-255 | 1.7                  | 25.5                   | 60                  | 3                          | 4,970                          |
| UTDLX 2175-263 | 1.75                 | 26.3                   | 60                  | 3                          | 4,970                          |
| UTDLX 2180-270 | 1.8                  | 27                     | 60                  | 3                          | 4,970                          |
| UTDLX 2185-278 | 1.85                 | 27.8                   | 60                  | 3                          | 4,970                          |
| UTDLX 2190-285 | 1.9                  | 28.5                   | 60                  | 3                          | 4,970                          |
| UTDLX 2195-293 | 1.95                 | 29.3                   | 60                  | 3                          | 4,970                          |
| UTDLX 2200-300 | 2                    | 30                     | 60                  | 3                          | 4,970                          |
| UTDLX 2205-308 | 2.05                 | 30.8                   | 80                  | 3                          | 6,640                          |
| UTDLX 2210-315 | 2.1                  | 31.5                   | 80                  | 3                          | 5,500                          |
| UTDLX 2215-323 | 2.15                 | 32.3                   | 80                  | 3                          | 6,640                          |
| UTDLX 2220-330 | 2.2                  | 33                     | 80                  | 3                          | 5,500                          |
| UTDLX 2225-338 | 2.25                 | 33.8                   | 80                  | 3                          | 6,640                          |
| UTDLX 2230-345 | 2.3                  | 34.5                   | 80                  | 3                          | 5,500                          |
| UTDLX 2235-353 | 2.35                 | 35.3                   | 80                  | 3                          | 6,640                          |
| UTDLX 2240-360 | 2.4                  | 36                     | 80                  | 3                          | 5,500                          |
| UTDLX 2245-368 | 2.45                 | 36.8                   | 80                  | 3                          | 6,640                          |
| UTDLX 2250-375 | 2.5                  | 37.5                   | 80                  | 3                          | 5,500                          |
| UTDLX 2255-383 | 2.55                 | 38.3                   | 80                  | 3                          | 6,640                          |
| UTDLX 2260-390 | 2.6                  | 39                     | 80                  | 3                          | 5,500                          |
| UTDLX 2265-398 | 2.65                 | 39.8                   | 80                  | 3                          | 6,640                          |
| UTDLX 2270-405 | 2.7                  | 40.5                   | 80                  | 3                          | 5,500                          |
| UTDLX 2275-413 | 2.75                 | 41.3                   | 80                  | 3                          | 6,640                          |
| UTDLX 2280-420 | 2.8                  | 42                     | 80                  | 3                          | 5,500                          |
| UTDLX 2285-428 | 2.85                 | 42.8                   | 80                  | 3                          | 6,640                          |
| UTDLX 2290-435 | 2.9                  | 43.5                   | 80                  | 3                          | 5,500                          |
| UTDLX 2295-443 | 2.95                 | 44.3                   | 80                  | 3                          | 6,640                          |
| UTDLX 2300-450 | 3                    | 45                     | 80                  | 3                          | 5,500                          |

$\phi$ 3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square  
Long Neck  
Square

Radius

Radius  
Long Neck  
Radius  
Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball  
Long Neck  
Ball  
Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

Drill

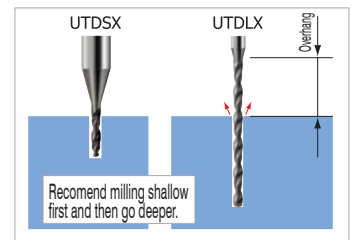
Technical Data

Drilling Conditions for UTDLX

| WORK MATERIAL | STRUCTURAL STEELS<br>SS400         |                    | CARBON STEELS<br>S50C              |                    | ALLOY STEELS<br>SCM / SUS          |                    | ALUMINUM ALLOYS<br>A5052           |                    |
|---------------|------------------------------------|--------------------|------------------------------------|--------------------|------------------------------------|--------------------|------------------------------------|--------------------|
| Velocity      | Vc=20~40 m/min                     |                    | Vc=20~40 m/min                     |                    | Vc=15~40 m/min                     |                    | Vc=25~60 m/min                     |                    |
| Diameter (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) |
| <b>0.3</b>    | 20,000                             | 50                 | 20,000                             | 50                 | 16,000                             | 40                 | 20,000                             | 650                |
| <b>0.35</b>   | 19,000                             | 60                 | 19,000                             | 60                 | 13,600                             | 50                 | 20,000                             | 700                |
| <b>0.4</b>    | 18,000                             | 80                 | 18,000                             | 80                 | 11,900                             | 50                 | 20,000                             | 800                |
| <b>0.45</b>   | 17,000                             | 100                | 17,000                             | 100                | 10,600                             | 60                 | 20,000                             | 850                |
| <b>0.5</b>    | 16,000                             | 120                | 16,000                             | 120                | 9,500                              | 60                 | 20,000                             | 920                |
| <b>0.55</b>   | 15,000                             | 140                | 15,000                             | 140                | 9,000                              | 70                 | 20,000                             | 1,050              |
| <b>0.6</b>    | 14,100                             | 140                | 14,100                             | 140                | 7,900                              | 70                 | 19,900                             | 1,150              |
| <b>0.7</b>    | 12,800                             | 140                | 12,800                             | 140                | 6,800                              | 70                 | 19,900                             | 1,230              |
| <b>0.8</b>    | 11,900                             | 140                | 11,900                             | 140                | 6,000                              | 70                 | 19,900                             | 1,310              |
| <b>0.9</b>    | 10,500                             | 140                | 10,500                             | 140                | 6,200                              | 70                 | 17,600                             | 1,350              |
| <b>1</b>      | 9,500                              | 150                | 9,500                              | 150                | 6,400                              | 70                 | 15,900                             | 1,400              |
| <b>1.5</b>    | 7,200                              | 150                | 7,200                              | 150                | 5,500                              | 70                 | 12,000                             | 1,470              |
| <b>2</b>      | 5,600                              | 150                | 5,600                              | 150                | 5,000                              | 70                 | 9,500                              | 1,590              |
| <b>2.5</b>    | 4,500                              | 150                | 4,500                              | 150                | 4,400                              | 70                 | 7,600                              | 1,640              |
| <b>3</b>      | 4,000                              | 150                | 4,000                              | 150                | 3,800                              | 70                 | 6,400                              | 1,700              |
| Peck Amount   | 0.5D                               |                    | 0.3D                               |                    | 0.1D                               |                    | 0.3D                               |                    |

Note:

- Apply pre-drilling more than 3D depth before deep drilling. Recommend UTDSX for pre-drilling.
- Recommend shallower drilling than flute length (under  $\phi$  1:1D,  $\phi$  1 and over: 0.5D).
- Recommend water soluble or oil coolant.
- Recommend oil coolant for Titanium Alloys and Heat Resistant Alloys.



- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



## Comparison of UTD (Carbide) and HSS Drill Bit SUS420J2 (Raw Material)

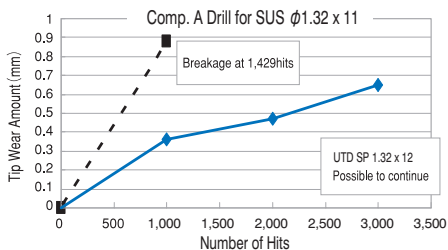
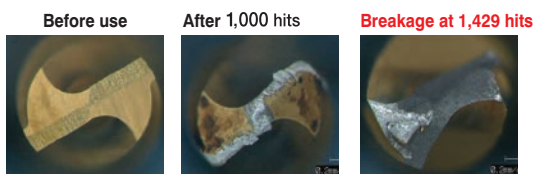
UTD can drill more than 2X holes compared to an HSS model

|               |  |
|---------------|--|
| Tool Size     | φ1.32 × 12 UTD proto type              |
| Spindle Speed | 5,000 min <sup>-1</sup> (Vc: 21 m/min) |
| Feed Rate     | 200 mm/min (f: 0.04 mm/rev.)           |
| Peck Amount   | 1.3 mm                                 |
| Depth         | 7 mm blind hole                        |

### UTD prototype



### HSS Drill (Company A: φ3 shank diameter with TIN coating for SUS)

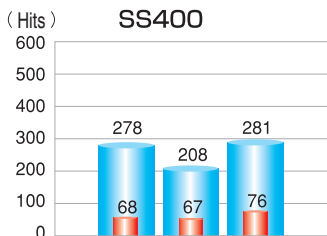
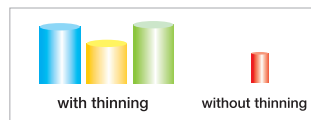


Flank wear comparison with HSS

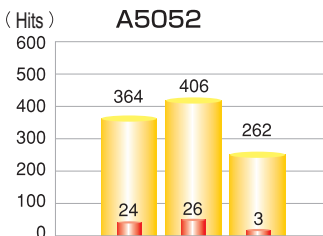
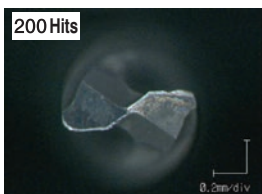
## Drilling test with various materials (Comparison of with / without thinning)

Smooth chip evacuation using the X-thinning design, offers greater resistance to breakage and more accurate drilling

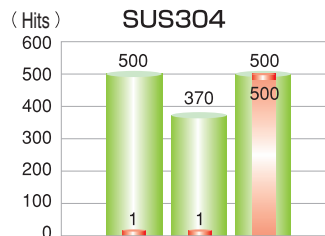
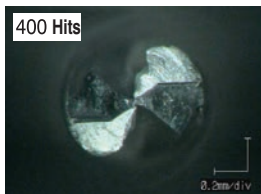
Drill Size : φ1.0 x 15  
 Tool : UTDLX 2100-150 (with thinning)  
 Test Tool: φ1.0 x 15 (without thinning)



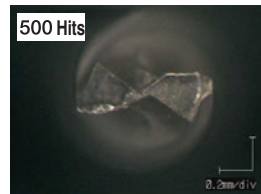
|               |  |
|---------------|--|
| Spindle Speed | 9,500 min <sup>-1</sup> (Vc: 30 m/min) |
| Feed Rate     | 400 mm/min (f: 0.042 mm/rev.)          |
| Peck Amount   | 0.2 mm                                 |
| Depth         | 14 mm blind hole                       |



|               |   |
|---------------|---|
| Spindle Speed | 15,900 min <sup>-1</sup> (Vc: 50 m/min) |
| Feed Rate     | 1,500 mm/min (f: 0.094 mm/rev.)         |
| Peck Amount   | 0.7 mm                                  |
| Depth         | 14 mm blind hole                        |



|               |  |
|---------------|--|
| Spindle Speed | 6,400 min <sup>-1</sup> (Vc: 20 m/min) |
| Feed Rate     | 150 mm/min (f: 0.023 mm/rev.)          |
| Peck Amount   | 0.2 mm                                 |
| Depth         | 14 mm blind hole                       |



- φ3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



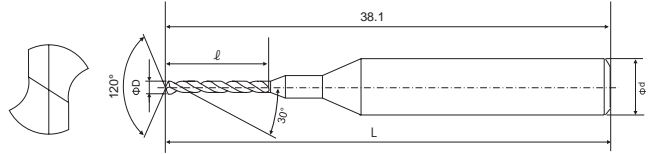
Size  $\phi 0.02 \sim \phi 0.1$  Refer to page 23 for material applications.

# PMD STD

h4 tolerance    3.175 shank    Shrink-fit compatible

## Features

Flute length L/D 10D  
 Diameter tolerance 0/-3 $\mu$ m  
 4-facet drill point



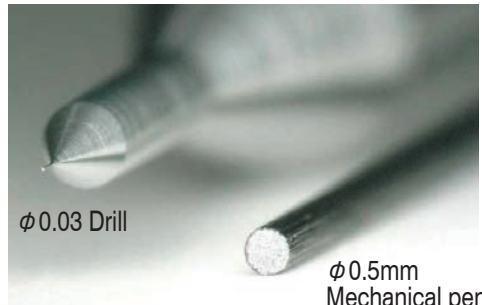
Total 17 models

Unit (mm)

| Product code | Model Number        | Diameter $\phi D$ | Diameter tolerance | Flute length $l$ | Overall length $L$ | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|---------------------|-------------------|--------------------|------------------|--------------------|-------------------------|--------------------------|
| 140-0001     | PMD STD 0.02 x 0.2  | 0.020             | +0.000/-0.003      | 0.2              | 38.1               | 3.175                   | 28,000                   |
| 140-0002     | PMD STD 0.025 x 0.3 | 0.025             |                    | 0.3              |                    |                         | 28,000                   |
| 140-0003     | PMD STD 0.03 x 0.3  | 0.030             |                    | 0.3              |                    |                         | 16,100                   |
| 140-0004     | PMD STD 0.035 x 0.4 | 0.035             |                    | 0.4              |                    |                         | 16,100                   |
| 140-0005     | PMD STD 0.04 x 0.4  | 0.040             |                    | 0.4              |                    |                         | 14,800                   |
| 140-0006     | PMD STD 0.045 x 0.5 | 0.045             |                    | 0.5              |                    |                         | 14,800                   |
| 140-0007     | PMD STD 0.05 x 0.5  | 0.050             |                    | 0.5              |                    |                         | 13,500                   |
| 140-0008     | PMD STD 0.055 x 0.6 | 0.055             |                    | 0.6              |                    |                         | 13,500                   |
| 140-0009     | PMD STD 0.06 x 0.6  | 0.060             |                    | 0.6              |                    |                         | 12,200                   |
| 140-0010     | PMD STD 0.065 x 0.7 | 0.065             |                    | 0.7              |                    |                         | 12,200                   |
| 140-0011     | PMD STD 0.07 x 0.7  | 0.070             |                    | 0.7              |                    |                         | 10,900                   |
| 140-0012     | PMD STD 0.075 x 0.8 | 0.075             |                    | 0.8              |                    |                         | 10,900                   |
| 140-0013     | PMD STD 0.08 x 0.8  | 0.080             |                    | 0.8              |                    |                         | 9,600                    |
| 140-0014     | PMD STD 0.085 x 0.9 | 0.085             |                    | 0.9              |                    |                         | 9,600                    |
| 140-0015     | PMD STD 0.09 x 0.9  | 0.090             |                    | 0.9              |                    |                         | 8,300                    |
| 140-0016     | PMD STD 0.095 x 1.0 | 0.095             |                    | 1.0              |                    |                         | 8,300                    |
| 140-0017     | PMD STD 0.1 X 1.0   | 0.100             |                    | 1.0              |                    |                         | 7,000                    |

## P Series Drill Features

Ultra-precision drill that utilizes the technology cultivated with PCB drills.  
 All sizes with diameter tolerance 0/-0.003 and shank diameter tolerance h4 can be used with shrink-fit holders.



- $\phi 3$ mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill
- Technical Data



Size  $\phi 0.02 \sim \phi 0.1$  Refer to page 23 for material applications.

# PMD PLT

h4  
tolerance3.175  
shankShrink-fit  
compatible

## Features

For pilot drilling  
Flute Length L/D 2D  
Diameter tolerance 0/-3  $\mu\text{m}$   
4-facet drill point

Total 11 models

Unit (mm)

| Product code | Model Number           | Diameter $\phi D$ | Diameter tolerance | Flute length $\ell$ | Overall length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|------------------------|-------------------|--------------------|---------------------|------------------|-------------------------|--------------------------|
| ※1           | PMD PLT 0.02 X 0.04    | 0.020             | ※1                 | 0.04                | 38.1             | 3.175                   | ※1                       |
| ※1           | PMD PLT 0.0225 X 0.045 | 0.0225            |                    | 0.045               |                  |                         | ※1                       |
| 140-0018     | PMD PLT 0.025 X 0.05   | 0.025             | -0.003/-0.006      | 0.05                |                  |                         | 28,000                   |
| 140-0019     | PMD PLT 0.03 X 0.06    | 0.030             | -0.005/-0.008      | 0.06                |                  |                         | 16,100                   |
| 140-0020     | PMD PLT 0.04 X 0.08    | 0.040             |                    | 0.08                |                  |                         | 14,800                   |
| 140-0021     | PMD PLT 0.05 X 0.10    | 0.050             |                    | 0.10                |                  |                         | 13,500                   |
| 140-0022     | PMD PLT 0.06 X 0.12    | 0.060             |                    | 0.12                |                  |                         | 12,200                   |
| 140-0023     | PMD PLT 0.07 X 0.14    | 0.070             |                    | 0.14                |                  |                         | 10,900                   |
| 140-0024     | PMD PLT 0.08 X 0.16    | 0.080             |                    | 0.16                |                  |                         | 9,600                    |
| 140-0025     | PMD PLT 0.09 X 0.18    | 0.090             |                    | 0.18                |                  |                         | 8,300                    |
| 140-0026     | PMD PLT 0.1 X 0.20     | 0.100             |                    | 0.20                |                  |                         | 7,000                    |

※ 1 These sizes are special items. Please contact our sales representative for details.

※ 2 Special sizes can be manufactured upon request. Please contact our sales representative for details.

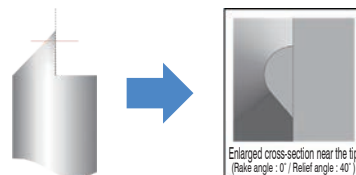
Refer to page 23 for material applications.

# PSM

h4  
tolerance3.175  
shankShrink-fit  
compatible

## Features

For Chamfering · Counter sink · Center drill  
Taper angle 90°



Total 1 model

Unit (mm)

| Product code | Model Number      | Diameter $\phi D$ | Half Included Angle A | Overall length L | Shank Diameter $\phi d$ | Suggested Retail Price ¥ |
|--------------|-------------------|-------------------|-----------------------|------------------|-------------------------|--------------------------|
| 141-9001     | PSM N603A 1.0 90° | 1.0               | 45°                   | 38.1             | 3.175                   | 6,000                    |

※ Special sizes can be manufactured upon request. Please contact our sales representative for details.

$\phi 3\text{mm}$  Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data

## φ0.06 Ultrafine hole processing on super engineering plastic

### Tool

Center PSM N603A 1.0 × 90° (Center depth 0.003 mm)

Pilot PMD PLT 0.06 × 0.12 (Pilot depth 0.009 mm)

Through PMD STD 0.06 × 0.6

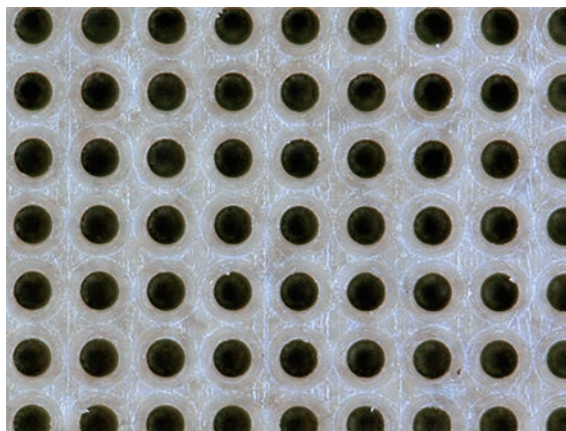
### Drilling condition

|                 |                          |
|-----------------|--------------------------|
| Drilling depth  | 0.4 mm                   |
| Hole wall pitch | 0.0415 mm                |
| Spindle speed   | 20,000 min <sup>-1</sup> |
| Feed rate       | 10 mm/min                |
| Peck Amount     | 0.005 mm/time            |
| Hit count       | 961 hits                 |
| Coolant         | Oil mist                 |

### Hole registration accuracy

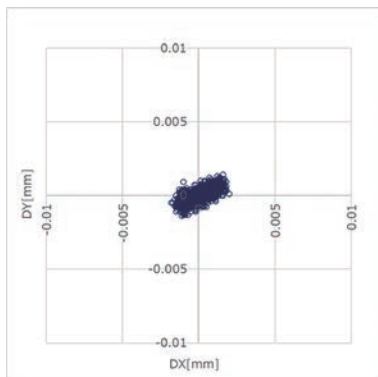
|               | Entry side | Exit side |
|---------------|------------|-----------|
| Avg + 3σ (mm) | 0.0021     | 0.0028    |
| Max (mm)      | 0.0021     | 0.0041    |

### Work surface

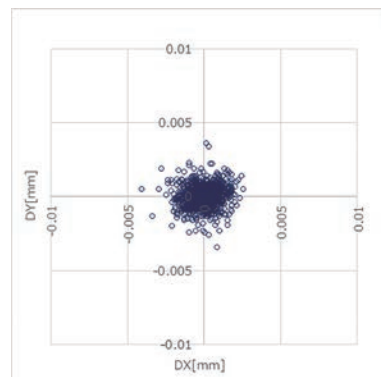


Hole diameter Avg ± 3σ φ0.0578 ± 0.0006

### Entry side



### Exit side



∅3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Square

Long Neck  
Square

Radius

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Taper

Barrel

Spiral  
V Cutter

**Drill**

Technical Data

# OPTECH-MES/MES-D50



## Non-contact dynamic run out measurement of the tool with Micro Eyes !

### Features

- Diameter & Run-out detection improves the milling quality and stability.**  
 Allowing the process to operate at the optimum condition by controlling the Machine spindle & tool setting.
- Prevents problems with tool life by detecting the tool tip.**  
 Detects tool damage & wear on micro tools.
- Price cut from the conventional product.**  
 Priced below the current OPTECH-Me/EDR-D20 measuring device.

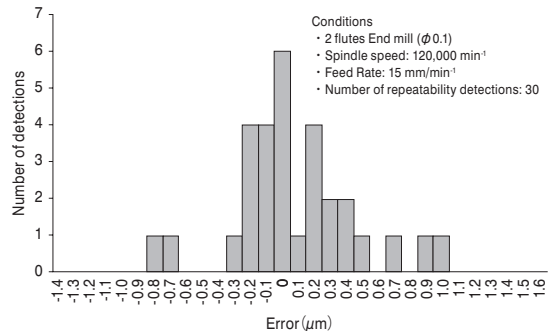
### Measuring example

#### ■ End mill Measuring Accuracy (Diameter)

| Spindle speed (min <sup>-1</sup> ) | End mill size (mm) |      |      |      |      |      |
|------------------------------------|--------------------|------|------|------|------|------|
|                                    | φ0.2               | φ0.5 | φ0.9 | φ2.0 | φ2.5 | φ3.0 |
| 0                                  | -1                 | 0    | 0    | 1    | 1    | 0    |
| 30,000                             | -1                 | 0    | -1   | 0    | -1   | -1   |
| 60,000                             | -1                 | -1   | -2   | -    | -    | -    |
| 120,000                            | -1                 | -    | -    | -    | -    | -    |

Unit (μm)

#### ■ Tool tip detection repeatability



φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

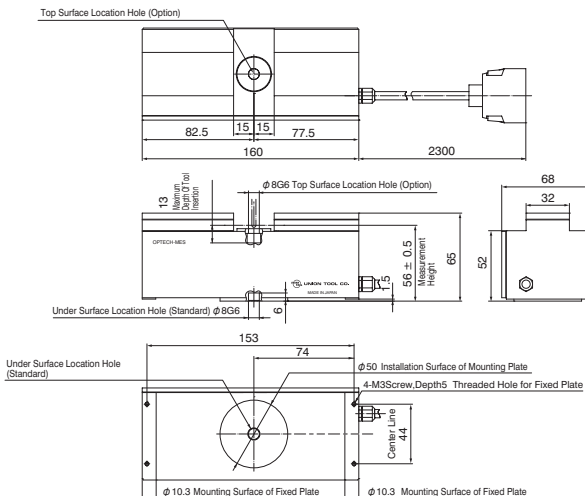
Spiral  
V Cutter

Drill

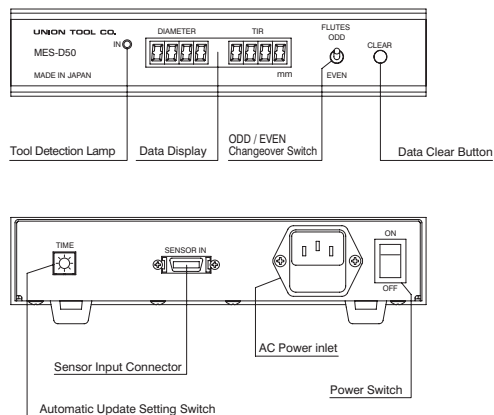
Technical Data

## Dimensions Plan (mm)

### OPTECH-MES(sensor)



### MES-D50(display)



### Optech Series OPTECH-MES/MES-D50

| Items                                       | Specification  |  |
|---|--|--|
| Measuring Items                             | <ul style="list-style-type: none"> <li>Tool Diameter, Dynamic run-out (Even number of flutes)</li> <li>Diameter including dynamic run-out (Odd number of flutes)</li> <li>Spindle run-out by pin gauge</li> <li>Tool Tip Detection</li> </ul>                |  |
| Measuring Range                             | φ0.05 ~ φ3.0 (mm)  |  |
| Range of Runout Measurement                 | 0 ~ 0.099 (mm)   |  |
| Resolution                                  | 1 (μm)   |  |
| Measuring Accuracy <sup>※1</sup>            | Diameter   | 2 (μm) (φ0.05 ~ φ1.5 (mm))<br>4 (μm) (φ1.5 ~ φ3.0 (mm))  |
|   | Run-out  | within 2 (μm)  |
|   | Tool Tip Detection <sup>※2</sup><br>(Repeatability)  | 3 (μm) (Diameter below φ0.2 (mm), Square End mills, Radius End mills)<br>2 (μm) (Diameter below φ3.0 (mm), Ball End mills, Drills) |
| Measuring Spindle Rotation                  | <ul style="list-style-type: none"> <li>within 120,000 (min<sup>-1</sup>) (φ0.05 ~ φ0.1 (mm) or below)</li> <li>within 60,000 (min<sup>-1</sup>) (φ0.1 ~ φ1.0 (mm) or below)</li> <li>within 30,000 (min<sup>-1</sup>) (φ1.0 ~ φ3.0 (mm) or below)</li> </ul> |  |
| Tool Tip Measurement Position <sup>※3</sup> | 56 mm ± 0.5 mm from bottom surface of the detector   |  |
| Measuring Point Range                       | within ± 0.02 (mm) <sup>※4</sup>   |  |
| Dimensions/Mass                             | <ul style="list-style-type: none"> <li>Sensor : W160 × D68 × H65 (mm) 0.7 (kg)</li> <li>Display : W200 × D200 × H42 (mm) 1.6 (kg)</li> </ul>   |  |
| Display                                     | <ul style="list-style-type: none"> <li>Diameter, Run-out display (Diameter, TIR), 4 digits each</li> <li>Tool tip detection indicator (IN) Lamp ON</li> </ul>  |  |
| Functions                                   | <ul style="list-style-type: none"> <li>Odd/even cutters switch (ODD/EVEN)</li> <li>Data refresh interval (TIME)</li> <li>No/Yes: Approximately 0.5s, 1.0s, 1.5s, 2.0s</li> <li>Clear (CLR)</li> </ul>  |  |
| Power Source                                | AC100 ~ 240 (V) 50/60 Hz   |  |
| Cable Length                                | 2.3 (m)  |  |
| Price                                       | ¥440,000   |  |

※1 Quantization errors are not included.

※2 Lamp lights when the tool is detected. Check the scale on milling machine for the actual value.

※3 Absolute position is different on individual tool. Adjust/Assemble the position within 56 ± 0.5mm.

※4 Set the tool position within ± 0.02 mm (XY direction) from the center of gauge hole.

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

Barrel

Spiral  
V Cutter

Drill

Technical Data



## Calculation of Milling Conditions

Proper tool selection, machine condition, feed and speeds are essential for successful milling. The optimum machining conditions are calculated using the formulas below.

### Formulas for calculation of end milling conditions

1. Velocity :  $V_C$  (m/min)

$$V_C = \frac{\pi \times D \times n}{1000}$$

$\pi = 3.14$  (Circular Constant)  
 $D =$  Outside Diameter (mm)  
 $n =$  Spindle Speed ( $\text{min}^{-1}$ )

2. Spindle Speed :  $n$  ( $\text{min}^{-1}$ )

$$n = \frac{1000 \times V_C}{\pi \times D}$$

$V_C =$  Velocity (m/min)  
 $\pi = 3.14$  (Circular Constant)  
 $D =$  Outside Diameter (mm)

3. Feed Rate :  $V_f$  (mm/min)

$$V_f = n \times z \times f_z$$

$n =$  Spindle Speed ( $\text{min}^{-1}$ )  
 $z =$  Number of flutes  
 $f_z =$  Feed per tooth (mm/t)

4. Feed per tooth :  $f_z$  (mm/t)

$$f_z = \frac{V_f}{n \times z}$$

$V_f =$  Feed Rate (mm/min)  
 $n =$  Spindle Speed ( $\text{min}^{-1}$ )  
 $z =$  Number of flutes

### Explanation of terms used in parameters

1. Velocity  $V_C$  [Unit: m/min] :

The milling distance of an optional point on the circumference per unit (1 minute)

Related Value —  $\left\{ \begin{array}{l} \text{Diameter } \phi D \text{ [mm]} : \text{ Twice the distance from the center of a circle (radius)} \\ \pi : \text{ Circular constant} = 3.14 \text{ (Unit : Nil)} \\ \text{Spindle Speed } n \text{ [min}^{-1}\text{]} : \text{ Revolutions per minute} \\ \text{[min}^{-1}\text{]} = \text{[rpm ; revolutions per minute]} \end{array} \right.$

φ3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

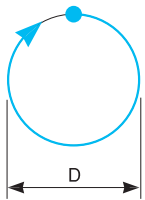
Barrel

Spiral  
V Cutter

Drill



- Length of Circumference = Diameter  $\times$  pi :  $\pi D$  [mm]
- Velocity  $V_c$ : Milling length per minute = Length of circumference  $\times$  Spindle rotation speed



$$V_c = \pi \times D \text{ [mm]} \times n \text{ [min}^{-1}\text{]}$$



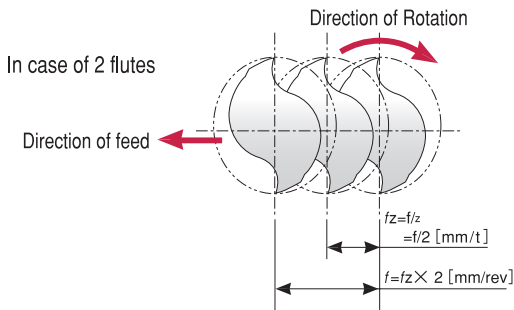
$$V_c = \frac{\pi \times D \text{ [mm]} \times n \text{ [min}^{-1}\text{]}}{1000} \text{ [m/min]}$$

Unit Conversion : 1 mm = 1/1000 m therefore....  
 $D \text{ [mm]} = D/1000 \text{ [m]}$

## 2. Feed per tooth $f_z$ [Unit:mm/t]

|               |   |  |   |
|---------------|---|--|---|
| Related Value | — | Feed Rate $V_f$ [mm/min]               | : Amount of feed per minute   |
|               |   | Spindle Speed $n$ [min <sup>-1</sup> ] | : Revolutions per minute<br>[min <sup>-1</sup> ] = [rpm ; revolutions per minute] |
|               |   | Number of Flutes $z$                   | : Number of flutes  |

- The amount of feed per rotation is described below. (rev = revolution)



$$f = \frac{V_f \text{ [mm/min]}}{n \text{ [rev/min]}} = \frac{V_f}{n} \left[ \frac{\text{mm}}{\text{min}} \right] \times \left[ \frac{\text{min}}{\text{rev}} \right]$$

$$= \frac{V_f}{n} \text{ [mm/rev]}$$

※ [min<sup>-1</sup>] = [rev/min]

- The amount of feed per flute is calculated using the feed rate divided by the number of flutes.

$$f_z = \frac{f \text{ [mm/rev]}}{z} = \frac{V_f}{n \times z} \text{ [mm/t]}$$

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
  - Square
  - Long Neck Square
- Radius
  - Radius
  - Long Neck Radius
  - Taper Neck Radius
- Ball / Long Shank Ball
  - Ball
  - Long Neck Ball
  - Taper Neck Ball
- Taper
  - Taper
- Barrel
- Spiral V Cutter
- Drill



## Using the Parameter Chart

### example 1

<How to calculate spindle speed and feed rate >

For example: C-CES2080 NAK55 (39HRC) high speed milling

- (1) Determine the velocity  $V_c$  based on the type of work material or its hardness.  
Parameter chart on page 177 shows  $V_c=200$  m/min.
- (2) We know the Outside diameter, we can set spindle speed ( $n$ ) and feed rate ( $V_f$ ).  
NAK55 is in the Prehardened Steel column. Velocity  $V_c$  is 200 m/min.  
From the table, the Outside diameter (D) is 8.0 mm, then  
 $n = 7900 \text{ min}^{-1}$  and  $V_f = 405 \text{ mm/min}$ .
- (3) Set the Z-axis cutting depth to approximately half of the outside diameter.

### example 2

<How to calculate feed rate >

- Case 1. You want to work on S50C with a C-CES2030 End Mill, but the milling machine has  $3,500 \text{ min}^{-1}$  maximum Spindle capability only. What is the feed rate with the conditions given?

Based on a feed per tooth  $0.0135 \text{ mm/t}$

$$V_f : = (n \times z \times f_z) = (3,500 \times 2 \times 0.0135) = 94.5$$

$n$  : Spindle speed

$z$  : Number of flutes

$f_z$  : Feed per tooth

$$n = 3,500 \text{ min}^{-1}, V_f : = 94.5 \text{ mm/min.}$$

<How to calculate the spindle speed>

- Case 2. You want to work on NAK80 with a C-CES2100 End Mill at velocity  $22 \text{ m/min}$ . What is the spindle speed for this application?

$$n = \frac{1000 V_c}{\pi D} = \frac{1000 \times 22}{3.14 \times 10} = 700 \text{ min}^{-1}$$

- Case 3. Calculating the spindle speed when side milling using C-CTE 4100-3

Work material: Carbon Steel

Velocity :  $40 \text{ m/min}$ .

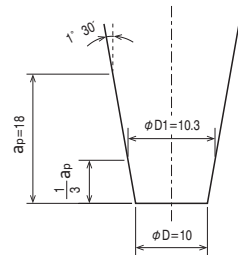
Outside Diameter D is calculated about  $1/3$  to  $1/2$  of cutting depth from bottom.

For example: If the blade length is  $35 \text{ mm}$ , cutting depth is  $18 \text{ mm}$ .

Outside Diameter  $D_1 = (1/3 \times \text{Axial Depth } a_p \times \tan(\text{half included angle})) \times 2 + \text{tip diameter}$

$$= (1/3 \times 18 \times \tan 1.5^\circ) \times 2 + \phi 10 \doteq 10.3$$

$$\text{Spindle speed } n = \frac{1000 V_c}{\pi D} = \frac{1000 \times 40}{3.14 \times 10.3} = 1,237 \text{ min}^{-1}$$



phi 3mm Shank  
V Series

UDC-PCD  
Series

CBN  
Series

Square

Long Neck  
Square

Radius

Long Neck  
Radius

Taper Neck  
Radius

Ball / Long  
Shank Ball

Long Neck  
Ball

Taper Neck  
Ball

Taper

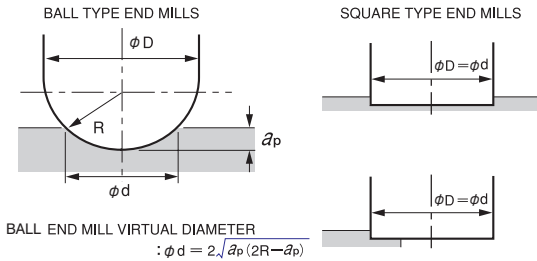
Barrel

Spiral  
V Cutter

Drill

Technical Data

## Diagram of End Mill Virtual Diameter



Square type diameter equals to the virtual diameter.  
Ball type virtual diameter will vary depending on the contact point with work material and milling depth.  
The velocity of Ball End Mill can be calculated by using the virtual diameter.

Velocity of virtual diameter (V) can be calculated by the following formula.

$$V_C(\text{m/min}) = \pi \times \phi d (\text{mm}) \times n (\text{min}^{-1}) / 1000$$

Ex.) With virtual diameter  $\phi 1$  mm and spindle speed 30,000 ( $\text{min}^{-1}$ ),

$$V_C(\text{m/min}) \text{ is } ; V_C(\text{m/min}) = 3.14 \times \phi 1 (\text{mm}) \times 30,000 (\text{min}^{-1}) / 1000 = 94.2 \text{ m/min}$$

Virtual Diameter of Ball End Mill (mm)

$a_p$  : Axial Depth (mm)

(Unit : mm)

| R \ $a_p$ | 0.01  | 0.02  | 0.03  | 0.04  | 0.05  | 0.1   | 0.15  | 0.2   | 0.25  | 0.3   | 0.4   |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| R0.1      | 0.087 | 0.120 | 0.143 | 0.160 | 0.173 | 0.200 | —     | —     | —     | —     | —     |
| R0.15     | 0.108 | 0.150 | 0.180 | 0.204 | 0.224 | 0.283 | 0.300 | —     | —     | —     | —     |
| R0.2      | 0.125 | 0.174 | 0.211 | 0.240 | 0.265 | 0.346 | 0.387 | 0.400 | —     | —     | —     |
| R0.25     | 0.140 | 0.196 | 0.237 | 0.271 | 0.300 | 0.400 | 0.458 | 0.490 | 0.500 | —     | —     |
| R0.3      | 0.154 | 0.215 | 0.262 | 0.299 | 0.332 | 0.447 | 0.520 | 0.566 | 0.592 | 0.600 | —     |
| R0.4      | 0.178 | 0.250 | 0.304 | 0.349 | 0.387 | 0.529 | 0.624 | 0.693 | 0.742 | 0.775 | 0.800 |
| R0.5      | 0.199 | 0.280 | 0.341 | 0.392 | 0.436 | 0.600 | 0.714 | 0.800 | 0.866 | 0.917 | 0.980 |
| R0.6      | 0.218 | 0.307 | 0.375 | 0.431 | 0.480 | 0.663 | 0.794 | 0.894 | 0.975 | 1.039 | 1.131 |
| R0.7      | 0.236 | 0.332 | 0.405 | 0.466 | 0.520 | 0.721 | 0.866 | 0.980 | 1.072 | 1.149 | 1.265 |
| R0.8      | 0.252 | 0.356 | 0.434 | 0.500 | 0.557 | 0.775 | 0.933 | 1.058 | 1.162 | 1.249 | 1.386 |
| R0.9      | 0.268 | 0.377 | 0.461 | 0.531 | 0.592 | 0.825 | 0.995 | 1.131 | 1.245 | 1.342 | 1.497 |
| R1        | 0.282 | 0.398 | 0.486 | 0.560 | 0.624 | 0.872 | 1.054 | 1.200 | 1.323 | 1.428 | 1.600 |
| R1.5      | 0.346 | 0.488 | 0.597 | 0.688 | 0.768 | 1.077 | 1.308 | 1.497 | 1.658 | 1.800 | 2.040 |
| R2        | 0.399 | 0.564 | 0.690 | 0.796 | 0.889 | 1.249 | 1.520 | 1.744 | 1.936 | 2.107 | 2.400 |
| R2.5      | 0.447 | 0.631 | 0.772 | 0.891 | 0.995 | 1.400 | 1.706 | 1.960 | 2.179 | 2.375 | 2.713 |
| R3        | 0.489 | 0.692 | 0.846 | 0.977 | 1.091 | 1.536 | 1.873 | 2.154 | 2.398 | 2.615 | 2.993 |
| R4        | 0.565 | 0.799 | 0.978 | 1.129 | 1.261 | 1.778 | 2.170 | 2.498 | 2.784 | 3.040 | 3.487 |
| R5        | 0.632 | 0.894 | 1.094 | 1.262 | 1.411 | 1.990 | 2.431 | 2.800 | 3.122 | 3.412 | 3.919 |
| R6        | 0.693 | 0.979 | 1.198 | 1.383 | 1.546 | 2.182 | 2.666 | 3.072 | 3.428 | 3.747 | 4.308 |

| R \ $a_p$ | 0.5   | 0.6   | 0.7   | 0.8   | 0.9   | 1     | 1.5   | 2     | 2.5   | 3      |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| R0.5      | 1.000 | —     | —     | —     | —     | —     | —     | —     | —     | —      |
| R0.6      | 1.183 | 1.200 | —     | —     | —     | —     | —     | —     | —     | —      |
| R0.7      | 1.342 | 1.386 | 1.400 | —     | —     | —     | —     | —     | —     | —      |
| R0.8      | 1.483 | 1.549 | 1.587 | 1.600 | —     | —     | —     | —     | —     | —      |
| R0.9      | 1.612 | 1.697 | 1.755 | 1.789 | 1.800 | —     | —     | —     | —     | —      |
| R1        | 1.732 | 1.833 | 1.908 | 1.960 | 1.990 | 2.000 | —     | —     | —     | —      |
| R1.5      | 2.236 | 2.400 | 2.538 | 2.653 | 2.750 | 2.828 | 3.000 | —     | —     | —      |
| R2        | 2.646 | 2.857 | 3.040 | 3.200 | 3.341 | 3.464 | 3.873 | 4.000 | —     | —      |
| R2.5      | 3.000 | 3.250 | 3.470 | 3.666 | 3.842 | 4.000 | 4.583 | 4.899 | 5.000 | —      |
| R3        | 3.317 | 3.600 | 3.852 | 4.079 | 4.285 | 4.472 | 5.196 | 5.657 | 5.916 | 6.000  |
| R4        | 3.873 | 4.214 | 4.521 | 4.800 | 5.056 | 5.292 | 6.245 | 6.928 | 7.416 | 7.746  |
| R5        | 4.359 | 4.750 | 5.103 | 5.426 | 5.724 | 6.000 | 7.141 | 8.000 | 8.660 | 9.165  |
| R6        | 4.796 | 5.231 | 5.625 | 5.987 | 6.321 | 6.633 | 7.937 | 8.944 | 9.747 | 10.392 |

- Ø3mm Shank V Series
- UDC-PCD Series
- CBN Series
- Square
- Long Neck Square
- Radius
- Long Neck Radius
- Taper Neck Radius
- Ball / Long Shank Ball
- Long Neck Ball
- Taper Neck Ball
- Taper
- Barrel
- Spiral V Cutter
- Drill

Technical Data

Material Accepting Inspection

Chamfering

Shouldering

Shank Diameter Finishing



Mitsuke Factory

Groove Grinding



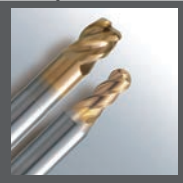
## End Mills' Production Flow

We can flexibly deal with highly accurate grinding and complicated shape machining using our in-house developed production facilities at Mitsuke Factory, our factory dedicated to end mill manufacturing, located in Niigata Prefecture. We also develop inspection equipment for various processes and precise radius measuring instruments for ball end mills internally under our strict quality control system.

Washing



Coating



Radius Inspection



Marking

Final Inspection

Packaging and Labeling

φ3mm Shank V Series

UDC-PCD Series

CBN Series

Square

Long Neck Square

Radius

Long Neck Radius

Taper Neck Radius

Ball / Long Shank Ball

Long Neck Ball

Taper Neck Ball

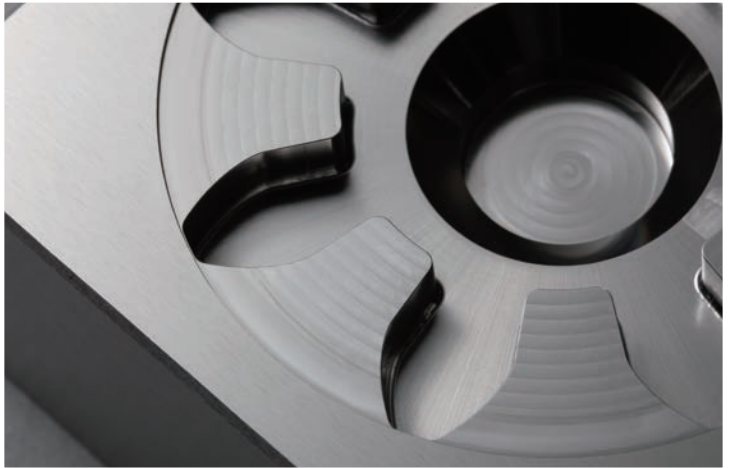
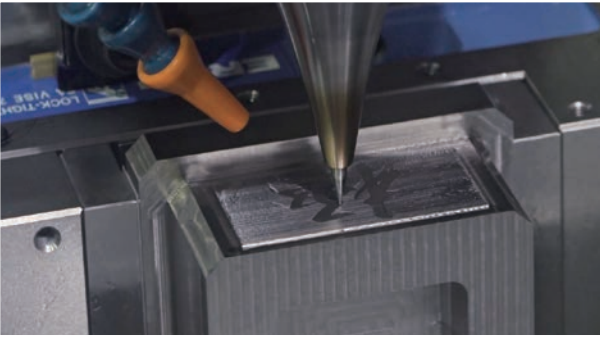
Taper

Barrel

Spiral V Cutter

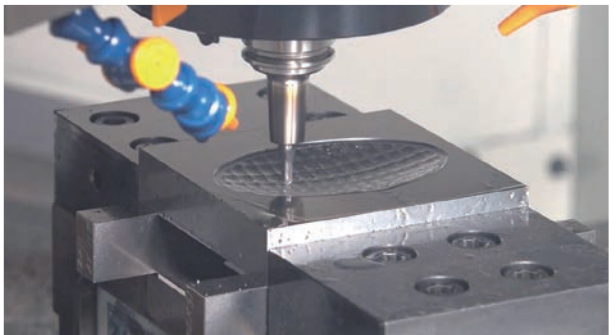
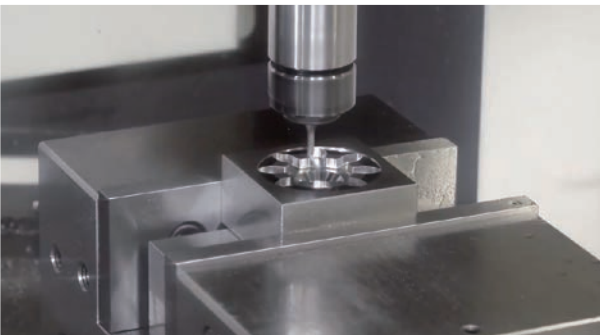
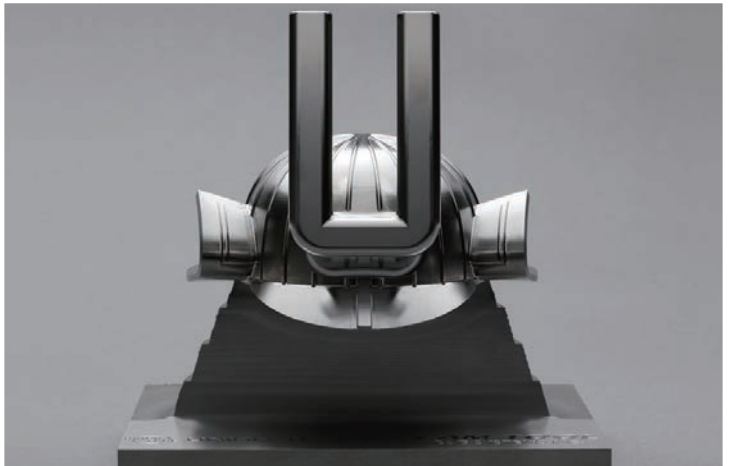
Drill

Technical Data



# Milling Videos

<https://www.uniontool.co.jp/en/product/endmill/movie/>



# UNION TOOL GROUP

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### TECHNICAL CENTER

### NAGAOKA SALES OFFICE

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## MITSUKE FACTORY

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Scan here to view

1. Website catalogs
2. Catalog revision information



## UNION TOOL CO.

<https://www.uniontool.co.jp/en/>

Price & Specifications are subject to change without notice.