

**UNION  
TOOL**

# Tungsten Carbide End Mills

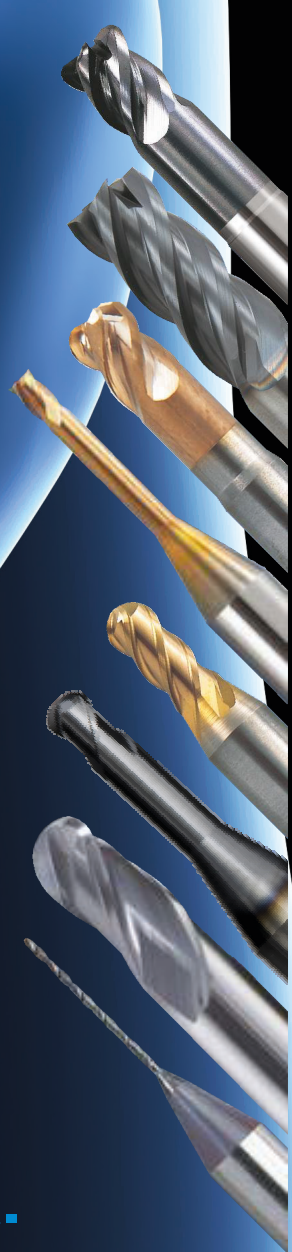
**UNIMAX Series**

**Vol. 1**

*Medical applications*



**UNION TOOL EUROPE S.A.**



# Union Tool Presentation

Union Tool CO. is a global based leader in medical technology that consistently delivers exceptional results. We work with respected medical professionals to advance meaningful innovation, improve productivity and performance and supplying quality products time and time again. Our goal is to be the Provider and Partner of choice.

Union Tool Co is known for its world-class products and a leadership team that sets a company standard of excellence.

Union Tool Europe S.A. is a wholly owned subsidiary of Union Tool CO. in Japan. The European office was founded in 1986 in Neuchâtel in Switzerland in the heart of the Swiss watch making industry.

Union Tool Europe S.A. has pan-European distribution network who is committed to offering the best service and support. The objectives of our supply chain partners are:

- To be close to our customers in order to fully understand their needs and requirements.
- To support our customers in improving their productivity by supplying Union Tool's state of the art products.
- To offer world-class logistics and technical support.

## Our relationship to our customers:

We foster long-term partnerships with our customers based on openness, honesty and trust. We focus on the needs and wishes of our customers. Our focus is on intense research into new materials, improved coatings and future-oriented technologies. We will perform customer specific tool developments in our technical centre in Japan and then carry out the qualification trials onsite with the customer.

## Japanese Precision and Innovation:

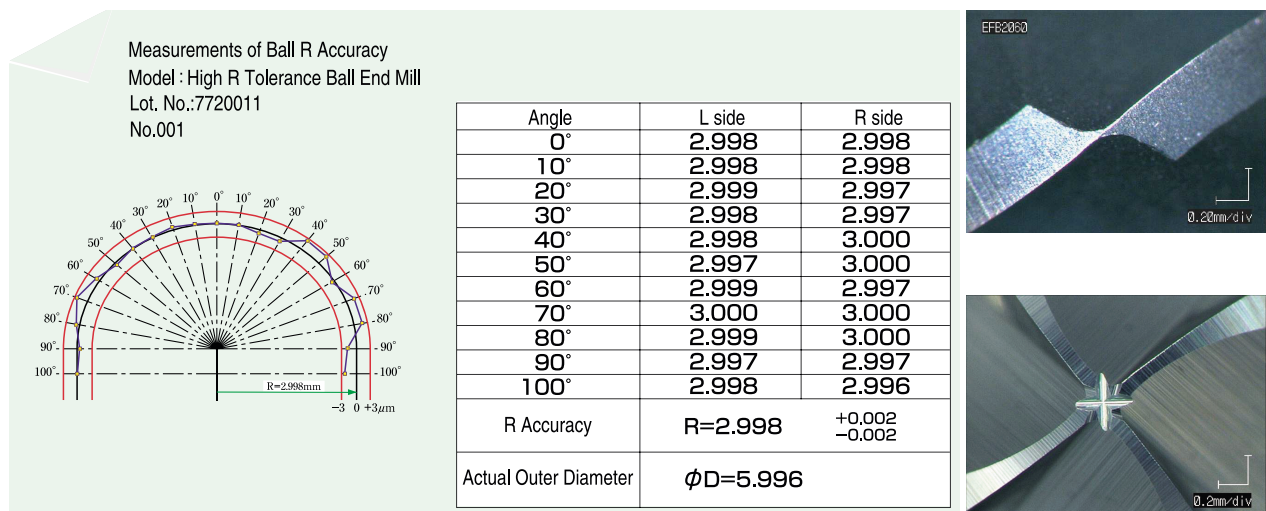
At Union Tool CO., everything is "Made in Japan" - starting from research and development all the way to the design and production of our own unique manufacturing machines which are used to manufacture our products. This guarantees the renowned Japanese quality and precision. Quality controls in all phases of the manufacturing process ensure compliance with the strict requirements and guarantee that only products of flawless quality are delivered to our customers.

## Values that inspire:

- Union Tool design & Japanese precision
- Leadership & Excellence & Innovation
- Worldwide Experience
- ISO 9001 / 14001 certified

## Precision that speaks for itself:

At Union Tool "precision" is in our DNA and is present in everything that we do. We offer standard tools with +/-3 micron radius tolerances. We also offer this precision and quality time and time again and batch after batch.



Exceeding your expectations.

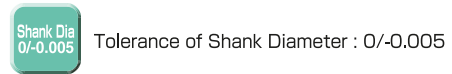
# Icons Definitions

unit : mm

## Tool Material



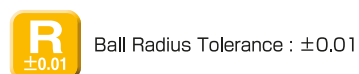
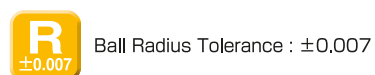
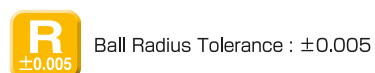
## Shank Diameter Tolerance



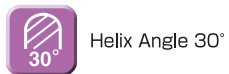
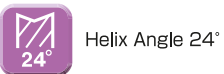
## Coating



## Ball Radius Tolerance



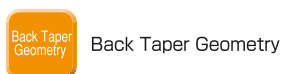
## Helix Angle



## Corner Radius Tolerance



## Geometry



# Index

## Alphabetical Order

| Model Number | Page | Characteristics |
|--------------|------|-----------------|
|--------------|------|-----------------|

### C

|       |    |  |
|-------|----|--|
| CFB   | 17 | 3 Flute Ball, <i>variable pitch, promotes high efficiency milling</i>      |
| CFLB  | 21 | 3 Flute Long Neck Ball, <i>variable pitch, various taper angles</i>        |
| CNRS  | 11 | 4 Flute Radius, <i>variable pitch for Titanium Alloys</i>                  |
| CRRS  | 12 | 4 Flute Long Neck Radius, <i>variable pitch, back taper</i>                |
| CSEB  | 16 | 2 Flute Ball, <i>New UTCOAT, for material up to 55HRC</i>                  |
| CSELB | 20 | 2 Flute Long Neck Ball, <i>New UTCOAT, for material up to 55HRC</i>        |
| C-UMD | 22 | 2 Flute Drill, <i>with a wide range of sizes</i>                           |
| CZS   | 6  | 4 Flute Square, <i>special geometry offers vertical milling capability</i> |

### H

|           |    |   |
|-----------|----|---|
| HFB-S     | 18 | 4 Flute Short Shank Ball, <i>enhances cutting performances</i>  |
| HLRS 4000 | 14 | 4 Flute Long Neck Radius, <i>precise, rigid, variable pitch</i> |
| HLS 2000  | 8  | 2 Flute Long Neck Square, <i>high accuracy for deep milling</i> |
| HLS 4000  | 9  | 4 Flute Long Neck Square, <i>high accuracy for deep milling</i> |
| HRRS-S    | 13 | 4 Flute Long Neck Radius, <i>high efficiency milling</i>        |


### U

|       |    |   |
|-------|----|---|
| UTDSX | 25 | 2 Flute Drill, <i>with Short Flute, excellent hole accuracy</i> |
|-------|----|---|


# Tool Type

| Model Number | Appearance | Size | Number of Flutes | Process  |                |           | Work Material   |          |               |
|--------------|------------|------|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|              |            |      |                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |

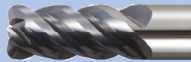
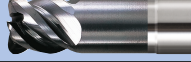

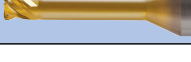
## Square

|     |   |          |   |   |   |   |   |   |   |
|-----|---|----------|---|---|---|---|---|---|---|
| CZS |  | Ø1 - Ø20 | 4 | ■ | ■ | ■ | ● | ● | ● |
|-----|---|----------|---|---|---|---|---|---|---|




## Long Neck Square

|          |   |           |   |   |   |   |   |   |   |
|----------|---|-----------|---|---|---|---|---|---|---|
| HLS 2000 |  | Ø0.1 - Ø6 | 2 | ■ | ■ | ■ | ● | ● | ● |
| HLS 4000 |  | Ø1 - Ø6   | 4 | ■ | ■ | ■ | ● | ● | ● |



## Radius & Long Neck Radius

|           |   |           |   |   |   |   |   |   |   |
|-----------|---|-----------|---|---|---|---|---|---|---|
| CNRS      |  | Ø6 - Ø12  | 4 | ■ | ■ | ■ | ● | ● | ● |
| CRRS      |  | Ø2 - Ø12  | 4 | ■ | ■ | ■ | ● | ● | ● |
| HRRS-S    |  | Ø2 - Ø12  | 4 | ■ | ■ | ■ | ● | ● | ● |
| HLRS 4000 |  | Ø0.8 - Ø6 | 4 | ■ | ■ | ■ | ● | ● | ● |



## Ball

|       |   |            |   |   |   |   |   |   |   |
|-------|---|------------|---|---|---|---|---|---|---|
| CSEB  |  | R0.05 - R6 | 2 | ■ | ■ | ■ | ● | ● | ● |
| CFB   |  | R0.3 - R6  | 3 | ■ | ■ | ■ | ● | ● | ● |
| HFB-S |  | R1 - R6    | 4 | ■ | ■ | ■ | ● | ● | ● |

## Long Neck Ball

|       |   |            |   |   |   |   |   |   |   |
|-------|---|------------|---|---|---|---|---|---|---|
| CSELB |  | R0.05 - R3 | 2 | ■ | ■ | ■ | ● | ● | ● |
| CFLB  |  | R0.3 - R3  | 3 | ■ | ■ | ■ | ● | ● | ● |

## Drill

|       |   |           |   |  |  |  |   |   |  |
|-------|---|-----------|---|--|--|--|---|---|--|
| C-UMD |  | Ø0.1 - Ø3 | 2 |  |  |  | ● | ● |  |
| UTDSX |  | Ø0.3 - Ø2 | 2 |  |  |  | ● | ● |  |

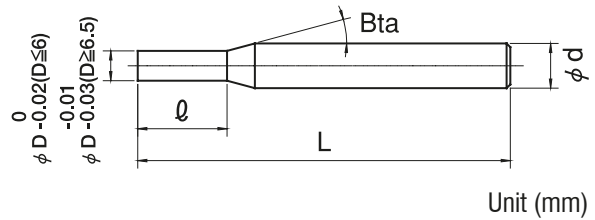
# 4 Flute

# CZS

Square  
Size Ø1 - Ø20



| Number of Flutes | Process  |                |           | Work Material   |          |               |
|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |
| 4                | ■        | ■              | ■         | ●               | ●        | ●             |



Applicable Work Material (● most suitable, ● suitable)  
Applicable Process (■ most suitable, ■ suitable)

The new tip geometry is ideal for vertical milling on horizontal surfaces.  
The carbide grade specified offers excellent resistance to chipping.  
The low friction characteristics of the coating offers excellent chip evacuation as well as longer tool life.

| Model Number  | Outside Diameter ØD | Length of Cut Ø | Shank Taper Angle Bta | Overall Length L | Shank Diameter Ød |
|---------------|---------------------|-----------------|-----------------------|------------------|-------------------|
| CZS 4010-0150 | 1                   | 1.50            | 16°                   | 50               | 4                 |
| CZS 4015-0225 | 1.5                 | 2.25            | 16°                   | 50               | 4                 |
| CZS 4020-0300 | 2                   | 3               | 16°                   | 50               | 4                 |
| CZS 4025-0375 | 2.5                 | 3.75            | 16°                   | 50               | 4                 |
| CZS 4030-0450 | 3                   | 4.50            | 16°                   | 60               | 6                 |
| CZS 4035-1000 | 3.5                 | 10              | 16°                   | 60               | 6                 |
| CZS 4040-0600 | 4                   | 6               | 16°                   | 60               | 6                 |
| CZS 4045-1100 | 4.5                 | 11              | 16°                   | 60               | 6                 |
| CZS 4050-0750 | 5                   | 7.50            | 16°                   | 60               | 6                 |
| CZS 4060-0900 | 6                   | 9               | -                     | 60               | 6                 |
| CZS 4070-1050 | 7                   | 10.50           | 16°                   | 70               | 8                 |
| CZS 4080-1200 | 8                   | 12              | -                     | 70               | 8                 |
| CZS 4090-1350 | 9                   | 13.50           | 16°                   | 80               | 10                |
| CZS 4100-1500 | 10                  | 15              | -                     | 80               | 10                |
| CZS 4110-1650 | 11                  | 16.50           | 16°                   | 100              | 12                |
| CZS 4120-1800 | 12                  | 18              | -                     | 100              | 12                |

| Model Number  | Outside Diameter (mm) | Length of Cut (mm) | Stainless Steel (SUS304)<br>Use water soluble coolant. |                    |          | Titanium (Grade 5) |                                    |                    |          |              |
|---------------|-----------------------|--------------------|--|--------------------|----------|--------------------|------------------------------------|--------------------|----------|--------------|
|               |                       |                    | Spindle Speed (min <sup>-1</sup> )                     | Feed Rate (mm/min) |          |                    | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) |          |              |
|               |                       |                    |  | Vertical Milling   | Slotting | Side Milling       |                                    | Vertical Milling   | Slotting | Side Milling |
| CZS 4010-0150 | 1                     | 1.5                | 14,500   | 150                | 250      | 1,000*             | 11,600                             | 120                | 100      | 800          |
| CZS 4015-0225 | 1.5                   | 2.25               | 13,000   | 150                | 270      | 1,500*             | 10,400                             | 120                | 100      | 1200         |
| CZS 4020-0300 | 2                     | 3                  | 10,000   | 100                | 270      | 1,500*             | 8,000                              | 80                 | 150      | 1200         |
| CZS 4025-0375 | 2.5                   | 3.75               | 8,000  | 100                | 300      | 2,000*             | 6,400                              | 80                 | 150      | 1600         |
| CZS 4030-0450 | 3                     | 4.50               | 6,800  | 80                 | 300      | 2,000*             | 5,440                              | 60                 | 200      | 1600         |
| CZS 4035-1000 | 3.5                   | 10                 | 5,700  | 90                 | 350      | 1,150              | 4,700                              | 70                 | 200      | 920          |
| CZS 4040-0600 | 4                     | 6                  | 5,700  | 90                 | 350      | 1,150              | 4,560                              | 70                 | 250      | 920          |
| CZS 4045-1100 | 4.5                   | 11                 | 4,800  | 100                | 400      | 1,300              | 4,200                              | 70                 | 250      | 960          |
| CZS 4050-0750 | 5                     | 7.50               | 4,800  | 100                | 400      | 1,300              | 3,840                              | 80                 | 300      | 1040         |
| CZS 4060-0900 | 6                     | 9                  | 4,000  | 100                | 400      | 1,300              | 3,200                              | 80                 | 300      | 1040         |
| CZS 4070-1050 | 7                     | 10.50              | 3,200  | 100                | 350      | 1,300              | 2,560                              | 80                 | 300      | 1040         |
| CZS 4080-1200 | 8                     | 12                 | 2,400  | 90*                | 300      | 1,200              | 1,920                              | 70                 | 300      | 960          |
| CZS 4090-1350 | 9                     | 13.50              | 1,800  | 90*                | 250      | 1,100              | 1,440                              | 70                 | 350      | 880          |
| CZS 4100-1500 | 10                    | 15                 | 1,400  | 80*                | 200      | 1,000              | 1,120                              | 60                 | 350      | 800          |
| CZS 4110-1650 | 11                    | 16.50              | 1,250  | 80*                | 200      | 900                | 1,000                              | 60                 | 350      | 720          |
| CZS 4120-1800 | 12                    | 18                 | 1,250  | 70*                | 180      | 900                | 1,000                              | 60                 | 350      | 720          |

Milling Amount (mm)

Depth: 0.25D  
\* Max 2mm

$a_p$  : 1D

$a_e$ : Length of Cut  
 $a_e \leq 0.1D, a_e \leq 0.05D^*$

Depth: 0.2 D  
\* Max 2mm

$a_p$  : 0.5D

$a_e$ : Length of Cut  
 $a_e \leq 0.2 D$

\* 49 models available in total from Diameter 1mm to 20mm with various length of cut from 1.5 to 3 X diameter.  
For more details please ask your distributor.

# 4 Flute

4 Flute UTCOAT Square End Mill for Part Milling

## CZS The 2 in 1 Advantage

Patented special end profile design

### Drilling and Milling with a Single Tool! 1/2 Cycle Time!

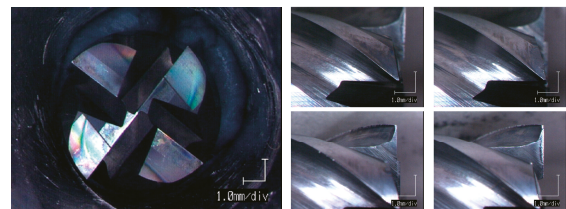


Drilling and Milling: 144min  
**CZS → 72 min**

|                       |                         |
|-----------------------|-------------------------|
| Tool                  | φ 8x12mm Length of Cut  |
| Work Material         | SCM420H                 |
| Spindle Speed         | 2,700 min <sup>-1</sup> |
| Z-Drilling Feed Rate  | 220 mm/min              |
| X-Y Milling Feed Rate | 500 mm/min              |
| Coolant               | Water Soluble           |



Pocket Size:  
9mm×15mm×4mm



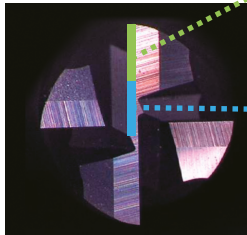
More tool life left after milling 864 holes (32 pieces)!

Z-drilling: 1mm depth x 4 times Dwell: 0.1sec

### Drilling Mechanism

#### Normal 4 Flutes

Conventional End Profile

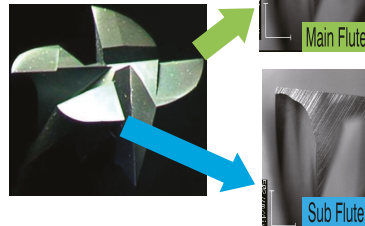


Chips made by the main flutes outer edge → Bigger

Chips made by the inner edge → Trapped

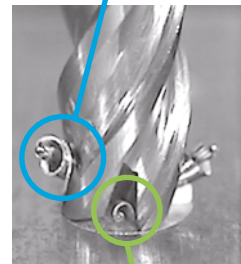
Normal 4 flute end mill easily clogs  
**Impossible to Drill**

The outer edge of the main flutes are not used in the drilling cycle



Gap on Main Flute CZS

Big chips come from the sub flute



Small chips come from the main flute

Chips made by the main flutes inner edge evacuate smoothly  
**Giving High Speed Drilling**

### Variable Pitch Prevents Chattering!

|                       |                            |
|-----------------------|----------------------------|
| Tool                  | φ 6.5x16mm Length of Cut   |
| Work Material         | S45C (φ 18)                |
| Spindle Speed         | 2,200min <sup>-1</sup>     |
| Z-Drilling Feed Rate  | 100mm/min                  |
| X-Y Milling Feed Rate | 400mm/min                  |
| Axial Depth $a_p$     | 3mm                        |
| Overhang              | 25mm                       |
| Coolant               | Air Blow (Through Spindle) |



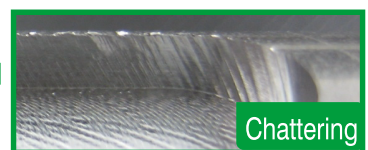
Cantilevered work piece

CZS



Excellent Surface Finish

Conventional 4 Flutes



Chattering

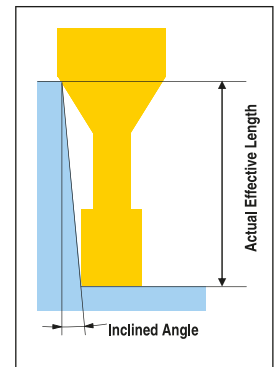
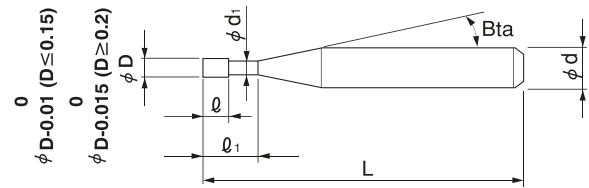
# 2 Flute

# HLS 2000

Long Neck Square  
Size Ø0.1 - Ø6



| Number of Flutes | Process  |                |           | Work Material   |          |               |
|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |
| 2                | ■        | ■              | ■         | ●               | ●        | ●             |



Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)

**HARDMAX** Coating offers outstanding heat resistance and low friction properties for deep milling.

High accuracy : Diameter Tolerance 0 / -0.015 mm.

Longer tool life with **HARDMAX** Coating.

Unit (mm)

| Model Number | Outside Diameter ØD | Effective Length $l_1$ | Length of Cut $l$ | Neck Diameter Ød <sub>1</sub> | Shank Taper Angle Bta | Overall Length L | Shank Diameter Ød | Effective Length by Inclined Angles |      |       |      |       |
|--------------|---------------------|------------------------|-------------------|-------------------------------|-----------------------|------------------|-------------------|-------------------------------------|------|-------|------|-------|
|              |                     |                        |                   |                               |                       |                  |                   | 30°                                 | 1°   | 1°30' | 2°   | 3°    |
| HLS 2005-015 | 0.5                 | 1.5                    | 0.7               | 0.48                          | 16°                   | 45               | 4                 | 1.83                                | 1.99 | 2.13  | 2.25 | 2.48  |
| HLS 2005-020 |                     | 2                      |                   |                               |                       |                  |                   | 2.37                                | 2.56 | 2.71  | 2.85 | 3.09  |
| HLS 2005-025 |                     | 2.5                    |                   |                               |                       |                  |                   | 2.92                                | 3.12 | 3.29  | 3.43 | 3.69  |
| HLS 2005-030 |                     | 3                      |                   |                               |                       |                  |                   | 3.45                                | 3.68 | 3.85  | 4.01 | 4.28  |
| HLS 2007-020 | 0.7                 | 2                      | 1                 | 0.68                          | 16°                   | 45               | 4                 | 2.39                                | 2.62 | 2.80  | 2.96 | 3.24  |
| HLS 2007-040 |                     | 4                      |                   |                               |                       |                  |                   | 4.57                                | 4.86 | 5.09  | 5.29 | 5.69  |
| HLS 2007-060 |                     | 6                      |                   |                               |                       |                  |                   | 6.70                                | 7.05 | 7.32  | 7.57 | 8.14  |
| HLS 2008-030 | 0.8                 | 3                      | 1.2               | 0.78                          | 16°                   | 45               | 4                 | 3.49                                | 3.75 | 3.96  | 4.14 | 4.32  |
| HLS 2008-040 |                     | 4                      |                   |                               |                       |                  |                   | 4.57                                | 4.86 | 5.09  | 5.29 | 5.69  |
| HLS 2008-050 |                     | 5                      |                   |                               |                       |                  |                   | 5.64                                | 5.96 | 6.21  | 6.43 | 6.92  |
| HLS 2008-060 |                     | 6                      |                   |                               |                       |                  |                   | 6.70                                | 7.05 | 7.32  | 7.57 | 8.14  |
| HLS 2008-080 |                     | 8                      |                   |                               |                       |                  |                   | 8.81                                | 9.20 | 9.52  | 9.85 | 10.59 |

for Chrome Cobalt Milling Conditions please refer to page 115 : Hardened Steel 45 - 55 HRC in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 26).

| Work Material |                       |                       |     | Stainless Steel                   |               |                        | Titanium (Grade 5)<br>Use water soluble coolant. |               |                        | Radial Depth            |
|---------------|-----------------------|-----------------------|-----|-----------------------------------|---------------|------------------------|--|---------------|------------------------|-------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | L/D | Spindle Speed (mm <sup>-1</sup> ) | Feed (mm/min) | Axial Depth $a_p$ (mm) | Spindel Speed (min <sup>-1</sup> )               | Feed (mm/min) | Axial Depth $a_p$ (mm) | Radial Depth $a_e$ (mm) |
| HLS 2005      | 0.5                   | 1.5                   | 3   | 61,000                            | 870           | 0.017 - 0.027          | 61,000   | 670           | 0.015 - 0.025          | 0.139                   |
|               |                       | 2                     | 4   | 54,000                            | 760           | 0.014 - 0.023          | 54,000   | 560           | 0.011 - 0.020          | 0.098                   |
|               |                       | 3                     | 6   | 39,900                            | 530           | 0.008 - 0.015          | 39,900   | 430           | 0.005 - 0.015          | 0.016                   |
| HLS 2007      | 0.7                   | 2                     | 2.9 | 50,200                            | 1,040         | 0.027 - 0.045          | 50,200   | 940           | 0.025 - 0.04           | 0.375                   |
|               |                       | 4                     | 5.7 | 32,700                            | 630           | 0.015 - 0.026          | 32,700   | 530           | 0.01 - 0.02            | 0.047                   |
|               |                       | 6                     | 8.6 | 25,400                            | 450           | 0.009 - 0.015          | 25,400   | 350           | 0.005 - 0.015          | 0.014                   |
| HLS 2008      | 0.8                   | 3                     | 3.8 | 34,500                            | 790           | 0.029 - 0.049          | 34,500   | 690           | 0.025 - 0.045          | 0.108                   |
|               |                       | 4                     | 5   | 31,100                            | 700           | 0.024 - 0.04           | 31,100   | 600           | 0.02 - 0.04            | 0.080                   |
|               |                       | 6                     | 7.5 | 24,200                            | 510           | 0.013 - 0.022          | 24,200   | 410           | 0.01 - 0.02            | 0.024                   |

\* 184 models available in total from Diameter 0.1mm to 6mm with various length of cut from 3 to 15 X diameter  
For more details please ask your distributor.



# 4 Flute

## HLS 4000

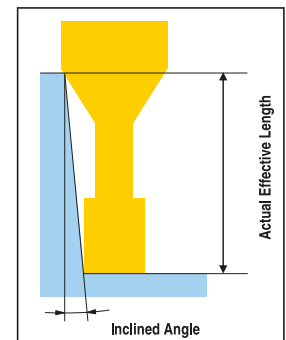
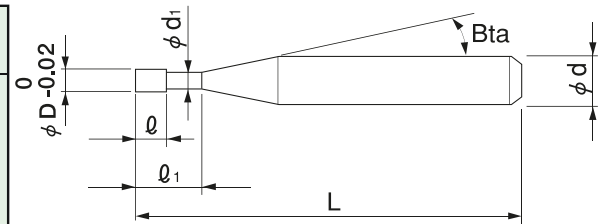
Long Neck Square  
Size Ø1 - Ø6



| Number of Flutes | Process  |                |           | Work Material   |          |               |
|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |
| 4                | ■        | ■              | ■         | ●               | ●        | ●             |

Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)



HARDMAX Coating offers outstanding heat resistance and low friction properties for deep milling.

High accuracy : Diameter tolerance 0 / -0.02 mm.

Longer tool life with HARDMAX Coating.

Unit (mm)

| Model Number | Outside Diameter<br>ØD | Effective Length<br>ℓ <sub>1</sub> | Length of Cut<br>ℓ | Neck Diameter<br>Ød <sub>1</sub> | Shank Taper Angle<br>Bta | Overall Length<br>L | Shank Diameter<br>Ød | Effective Length by Inclined Angles |       |       |                 |                 |
|--------------|------------------------|------------------------------------|--------------------|----------------------------------|--------------------------|---------------------|----------------------|-------------------------------------|-------|-------|-----------------|-----------------|
|              |                        |                                    |                    |                                  |                          |                     |                      | 30°                                 | 1°    | 1°30' | 2°              | 3°              |
| HLS 4010-040 | 1                      | 4                                  | 1                  | 0.95                             | 16°                      | 50                  | 4                    | 4.66                                | 4.93  | 5.15  | 5.34            | 5.74            |
| HLS 4010-060 |                        | 6                                  |                    |                                  |                          | 50                  | 4                    | 6.78                                | 7.10  | 7.36  | 7.62            | 8.19            |
| HLS 4010-080 |                        | 8                                  |                    |                                  |                          | 50                  | 4                    | 8.88                                | 9.25  | 9.56  | 9.90            | 10.64           |
| HLS 4012-060 | 1.2                    | 6                                  | 1.2                | 1.14                             | 16°                      | 50                  | 4                    | 6.18                                | 6.38  | 6.60  | 6.83            | 7.34            |
| HLS 4012-080 |                        | 8                                  |                    |                                  |                          | 50                  | 4                    | 8.24                                | 8.51  | 8.80  | 9.11            | 9.79            |
| HLS 4012-100 |                        | 10                                 |                    |                                  |                          | 50                  | 4                    | 10.31                               | 10.64 | 11.00 | 11.38           | 12.24           |
| HLS 4015-060 | 1.5                    | 6                                  | 1.5                | 1.44                             | 16°                      | 50                  | 4                    | 6.18                                | 6.38  | 6.60  | 6.83            | 7.34            |
| HLS 4015-080 |                        | 8                                  |                    |                                  |                          | 50                  | 4                    | 8.24                                | 8.51  | 8.80  | 9.11            | 9.79            |
| HLS 4015-100 |                        | 10                                 |                    |                                  |                          | 50                  | 4                    | 10.31                               | 10.64 | 11.00 | 11.38           | 12.24           |
| HLS 4018-060 | 1.8                    | 6                                  | 1.8                | 1.71                             | 16°                      | 50                  | 4                    | 6.22                                | 6.42  | 6.64  | 6.87            | 7.39            |
| HLS 4018-080 |                        | 8                                  |                    |                                  |                          | 50                  | 4                    | 8.28                                | 8.55  | 8.84  | 9.15            | 9.83            |
| HLS 4018-100 |                        | 10                                 |                    |                                  |                          | 50                  | 4                    | 10.34                               | 10.68 | 11.04 | 11.42           | 12.28           |
| HLS 4018-120 |                        | 12                                 |                    |                                  |                          | 50                  | 4                    | 12.40                               | 12.81 | 13.24 | 13.70           | 14.73           |
| HLS 4018-160 |                        | 16                                 |                    |                                  |                          | 60                  | 4                    | 16.53                               | 17.07 | 17.64 | 18.26           | 19.62           |
| HLS 4020-060 | 2                      | 6                                  | 2                  | 1.91                             | 16°                      | 50                  | 4                    | 6.22                                | 6.42  | 6.64  | 6.87            | 7.39            |
| HLS 4020-080 |                        | 8                                  |                    |                                  |                          | 50                  | 4                    | 8.28                                | 8.55  | 8.84  | 9.15            | 9.83            |
| HLS 4020-100 |                        | 10                                 |                    |                                  |                          | 50                  | 4                    | 10.34                               | 10.68 | 11.04 | 11.42           | 12.28           |
| HLS 4020-120 |                        | 12                                 |                    |                                  |                          | 50                  | 4                    | 12.40                               | 12.81 | 13.24 | 13.70           | 14.73           |
| HLS 4020-160 |                        | 16                                 |                    |                                  |                          | 60                  | 4                    | 16.53                               | 17.07 | 17.64 | 18.26           | No Interference |
| HLS 4025-080 | 2.5                    | 8                                  | 2.5                | 2.41                             | 16°                      | 50                  | 4                    | 8.28                                | 8.55  | 8.84  | 9.15            | 9.83            |
| HLS 4025-120 |                        | 12                                 |                    |                                  |                          | 50                  | 4                    | 12.40                               | 12.81 | 13.24 | 13.70           | No Interference |
| HLS 4025-160 |                        | 16                                 |                    |                                  |                          | 60                  | 4                    | 16.53                               | 17.07 | 17.64 | 18.26           | No Interference |
| HLS 4025-200 |                        | 20                                 |                    |                                  |                          | 60                  | 4                    | 20.66                               | 21.33 | 22.04 | No Interference | No Interference |
| HLS 4030-080 | 3                      | 8                                  | 3                  | 2.92                             | 16°                      | 50                  | 6                    | 8.28                                | 8.55  | 8.84  | 9.15            | 9.83            |
| HLS 4030-120 |                        | 12                                 |                    |                                  |                          | 50                  | 6                    | 12.40                               | 12.81 | 13.24 | 13.70           | 14.73           |
| HLS 4030-160 |                        | 16                                 |                    |                                  |                          | 60                  | 6                    | 16.53                               | 17.07 | 17.64 | 18.26           | 19.62           |
| HLS 4030-200 |                        | 20                                 |                    |                                  |                          | 60                  | 6                    | 20.66                               | 21.33 | 22.04 | 22.81           | 24.52           |

\*84 models available in total from Diameter 1mm to 6mm with various Effective Length from 4 to 15 X diameter.  
For more details please ask your distributor.

# 4 Flute

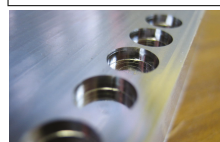
for Chrome Cobalt Milling Conditions please refer to page 145 : Hardened Steel 45 - 55 HRC in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 26).

| Work Material |                       |                       |     | Stainless Steel<br>Use oil soluble |                    |                        | Titanium<br>(Grade 5)<br>Use water soluble |                    |                        | Radial Depth            |
|---------------|-----------------------|-----------------------|-----|------------------------------------|--------------------|------------------------|--|--------------------|------------------------|-------------------------|
| Model Number  | Outside Diameter (mm) | Effective Length (mm) | L/D | 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) | Radial Depth $a_e$ (mm) |
| HLS 4010      | 1                     | 4                     | 4   | 21,000                             | 950                | 0.036                  | 21,000                                     | 850                | 0.030                  | 0.332                   |
|               |                       | 6                     | 6   | 19,400                             | 840                | 0.021                  | 19,400                                     | 740                | 0.020                  | 0.099                   |
|               |                       | 8                     | 8   | 17,800                             | 740                | 0.018                  | 17,800                                     | 640                | 0.015                  | 0.041                   |
| HLS 4012      | 1.2                   | 6                     | 5   | 18,200                             | 1,020              | 0.034                  | 18,200                                     | 920                | 0.030                  | 0.204                   |
|               |                       | 8                     | 6.7 | 16,700                             | 890                | 0.030                  | 16,700                                     | 790                | 0.025                  | 0.087                   |
|               |                       | 10                    | 8.3 | 15,200                             | 770                | 0.026                  | 15,200                                     | 670                | 0.02                   | 0.044                   |
| HLS 4015      | 1.5                   | 6                     | 4   | 16,800                             | 1,200              | 0.068                  | 16,800                                     | 1,100              | 0.050                  | 0.498                   |
|               |                       | 8                     | 5.3 | 15,500                             | 930                | 0.060                  | 15,500                                     | 830                | 0.045                  | 0.211                   |
|               |                       | 10                    | 6.7 | 14,100                             | 900                | 0.051                  | 14,100                                     | 800                | 0.040                  | 0.107                   |
| HLS 4018      | 1.8                   | 6                     | 3.3 | 14,900                             | 1,440              | 0.068                  | 14,900                                     | 1,300              | 0.060                  | 1.034                   |
|               |                       | 8                     | 4.4 | 14,600                             | 980                | 0.060                  | 14,600                                     | 800                | 0.050                  | 0.435                   |
|               |                       | 10                    | 5.6 | 12,500                             | 950                | 0.051                  | 12,500                                     | 750                | 0.045                  | 0.223                   |
|               |                       | 12                    | 6.7 | 11,000                             | 770                | 0.043                  | 11,000                                     | 600                | 0.040                  | 0.129                   |
|               |                       | 16                    | 8.9 | 9,000                              | 450                | 0.026                  | 9,000                                      | 350                | 0.020                  | 0.054                   |
| HLS 4020      | 2                     | 6                     | 3   | 14,500                             | 1,560              | 0.0668                 | 14,500                                     | 1,400              | 0.060                  | 1.574                   |
|               |                       | 8                     | 4   | 14,200                             | 1,000              | 0.060                  | 14,200                                     | 900                | 0.050                  | 0.665                   |
|               |                       | 10                    | 5   | 12,000                             | 980                | 0.051                  | 12,000                                     | 880                | 0.040                  | 0.340                   |
|               |                       | 12                    | 6   | 10,500                             | 790                | 0.043                  | 10,500                                     | 690                | 0.035                  | 0.197                   |
|               |                       | 16                    | 8   | 9,000                              | 500                | 0.026                  | 9,000                                      | 400                | 0.020                  | 0.083                   |
| HLS 4025      | 2.5                   | 8                     | 3.2 | 12,800                             | 1,020              | 0.081                  | 12,800                                     | 900                | 0.075                  | 1.622                   |
|               |                       | 12                    | 4.8 | 10,000                             | 810                | 0.056                  | 10,000                                     | 710                | 0.050                  | 0.481                   |
|               |                       | 16                    | 6.4 | 8,400                              | 590                | 0.040                  | 8,400                                      | 490                | 0.030                  | 0.202                   |
|               |                       | 20                    | 8   | 7,300                              | 490                | 0.030                  | 7,300                                      | 390                | 0.025                  | 0.104                   |
| HLS 4030      | 3                     | 8                     | 2.7 | 10,900                             | 1,080              | 0.093                  | 10,900                                     | 980                | 0.085                  | 2.361                   |
|               |                       | 12                    | 4   | 8,700                              | 830                | 0.073                  | 8,700                                      | 730                | 0.065                  | 0.996                   |
|               |                       | 16                    | 5.3 | 7,400                              | 670                | 0.058                  | 7,400                                      | 570                | 0.055                  | 0.420                   |
|               |                       | 20                    | 6.7 | 6,600                              | 560                | 0.045                  | 6,600                                      | 460                | 0.035                  | 0.216                   |

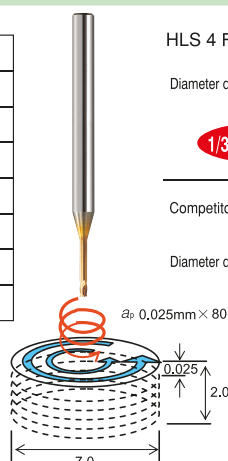
## Milling Example: SKD11 (60HRC) Pocket Milling

Tool: HLS  $\phi 1.5 \times$  effective length 10mm

|                    |                         |
|--------------------|-------------------------|
| Spindle Speed      | 7,000 min <sup>-1</sup> |
| Feed Rate          | 230 mm/min              |
| Axial Depth $a_p$  | 0.025 mm                |
| Radial Depth $a_e$ | 1.2 mm                  |
| Coolant            | Air blow (Nozzle)       |
| Overhang Length    | 18mm                    |
| Pocket Size        | $\phi 7 \times 2$ mm    |
| Cycle Time         | 17 minutes              |



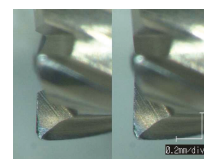
SKD11 (60HRC)



HLS 4 Flutes  $\phi 1.5 \times 10$

Diameter damage: 0.091mm

**1/3 and under!**



Competitor, 4 Flutes  $\phi 1.5 \times 10$

Diameter damage: 0.296mm



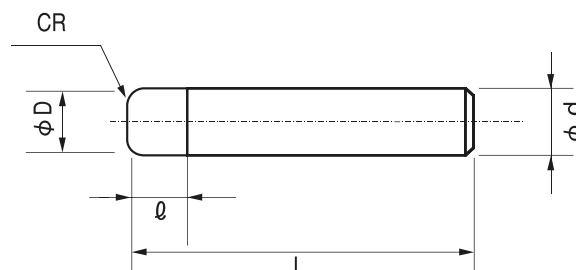
# 4 Flute

## CNRS

Corner Radius  
Size Ø6 - Ø12



| Number of Flutes | Process  |                |           | Work Material   |          |               |
|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |
| 4                | ■        | ■              | ■         | ●               | ●        | ●             |



Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)

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.

Unit (mm)

| Model Number    | Outside Diameter<br>ØD | Corner Radius<br>CR | Length of Cut<br>ℓ | Overall Length<br>L | Shank Diameter<br>Ød |
|-----------------|------------------------|---------------------|--------------------|---------------------|----------------------|
| CNRS 4060-10-16 | 6                      | R1                  | 16                 | 90                  | 6                    |
| CNRS 4080-10-16 | 8                      | R1                  | 16                 | 100                 | 8                    |
| CNRS 4100-10-26 | 10                     | R1                  | 26                 | 110                 | 10                   |
| CNRS 4100-15-26 | 10                     | R1.5                | 26                 | 110                 | 10                   |
| CNRS 4100-20-26 | 10                     | R2                  | 26                 | 110                 | 10                   |
| CNRS 4120-10-26 | 12                     | R1                  | 26                 | 120                 | 12                   |
| CNRS 4120-15-26 | 12                     | R1.5                | 26                 | 120                 | 12                   |
| CNRS 4120-20-26 | 12                     | R2                  | 26                 | 120                 | 12                   |

for Chrome Cobalt Milling Conditions please refer to page 161 : Inconel 718 in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 26).

| Work Material   |                          |                       | Stainless Steel<br>(SUS304)<br>Use water soluble coolant. |                       |                                       |  | Titanium<br>(Grade 5)                 |                       |                                       |  |
|-----------------|--------------------------|-----------------------|---|-----------------------|---------------------------------------|--|---------------------------------------|-----------------------|---------------------------------------|--|
| Model Number    | Outside Diameter<br>(mm) | Length of Cut<br>(mm) | Spindle Speed<br>(min <sup>-1</sup> )                     | Feed Rate<br>(mm/min) | a <sub>p</sub><br>Axial Depth<br>(mm) | a <sub>e</sub><br>Radial Depth<br>(mm) | Spindle Speed<br>(min <sup>-1</sup> ) | Feed Rate<br>(mm/min) | a <sub>p</sub><br>Axial Depth<br>(mm) | a <sub>e</sub><br>Radial Depth<br>(mm) |
| CNRS 4060-10-16 | 6                        | 16                    | 3,700   | 740                   | 4.8                                   | 0.3                                    | 3,700                                 | 740                   | 4.8                                   | 0.3                                    |
| CNRS 4080-10-16 | 8                        | 16                    | 2,800   | 700                   | 6.4                                   | 0.4                                    | 2,800                                 | 700                   | 6.4                                   | 0.4                                    |
| CNRS 4100-10-26 | 10                       | 26                    | 1,980   | 680                   | 8.0                                   | 0.5                                    | 1,980                                 | 680                   | 8.0                                   | 0.5                                    |
| CNRS 4100-15-26 | 10                       | 26                    | 2,090   | 680                   | 8.0                                   | 0.5                                    | 2,090                                 | 680                   | 8.0                                   | 0.5                                    |
| CNRS 4100-20-26 | 10                       | 26                    | 2,200   | 680                   | 8.0                                   | 0.5                                    | 2,200                                 | 680                   | 8.0                                   | 0.5                                    |
| CNRS 4120-10-26 | 12                       | 26                    | 1,665   | 650                   | 9.6                                   | 0.6                                    | 1,665                                 | 650                   | 9.6                                   | 0.6                                    |
| CNRS 4120-15-26 | 12                       | 26                    | 1,760   | 650                   | 9.6                                   | 0.6                                    | 1,760                                 | 650                   | 9.6                                   | 0.6                                    |
| CNRS 4120-20-26 | 12                       | 26                    | 1,850   | 650                   | 9.6                                   | 0.6                                    | 1,850                                 | 650                   | 9.6                                   | 0.6                                    |

\*8 models available in total from Diameter 6mm to 12mm with various corner radius from 1mm to 2mm.  
For more details please ask your distributor.

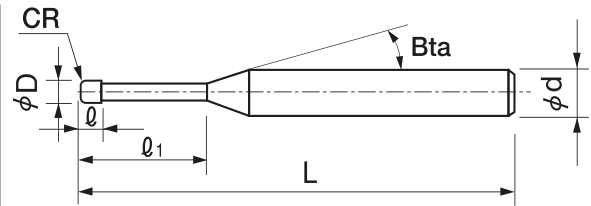
# 4 Flute

## CRRS

Long Neck Radius  
Size Ø2 - Ø12



| Number of Flutes | Process  |                |           | Work Material   |          |               |
|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |
| 4                | ■        | ■              | ■         | ●               | ●        | ●             |



Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)

UTCOAT offers longer tool life milling Heat Resistant Alloys.

Variable pitch, high helix and positive rake angle offer stable milling.

Reduced cutting force when using a helical approach or inclined angles.

Unit (mm)

| Model Number    | Outside Diameter<br>ØD | Corner Radius<br>CR | Effective Length<br>ℓ <sub>1</sub> | Length of Cut<br>ℓ | Neck Diameter<br>Ød <sub>1</sub> | Shank Taper Angle<br>Bta | Overall Length<br>L | Shank Diameter<br>Ød |
|-----------------|------------------------|---------------------|------------------------------------|--------------------|----------------------------------|--------------------------|---------------------|----------------------|
| CRRS 4020-05-06 | 2                      | R0.5                | 6                                  | 2                  | 1.91                             | 16°                      | 70                  | 4                    |
| CRRS 4030-08-09 | 3                      | R0.8                | 9                                  | 3                  | 2.92                             | 16°                      | 70                  | 6                    |
| CRRS 4040-05-12 | 4                      | R0.5                | 12                                 | 4                  | 3.82                             | 16°                      | 60                  | 6                    |
| CRRS 4040-10-12 | 4                      | R1                  | 12                                 | 4                  | 3.82                             | 16°                      | 70                  | 6                    |
| CRRS 4050-12-15 | 5                      | R1.2                | 15                                 | 5                  | 4.82                             | 16°                      | 70                  | 6                    |
| CRRS 4060-10-18 | 6                      | R1                  | 18                                 | 6                  | 5.82                             | -                        | 60                  | 6                    |
| CRRS 4060-15-18 | 6                      | R1.5                | 18                                 | 6                  | 5.82                             | -                        | 90                  | 6                    |
| CRRS 4080-10-26 | 8                      | R1                  | 26                                 | 8                  | 7.82                             | -                        | 70                  | 8                    |
| CRRS 4080-20-24 | 8                      | R2                  | 24                                 | 8                  | 7.82                             | -                        | 100                 | 8                    |
| CRRS 4100-10-30 | 10                     | R1                  | 30                                 | 10                 | 9.82                             | -                        | 80                  | 10                   |
| CRRS 4100-20-30 | 10                     | R2                  | 30                                 | 10                 | 9.82                             | -                        | 110                 | 10                   |
| CRRS 4120-20-36 | 12                     | R2                  | 36                                 | 12                 | 11.82                            | -                        | 120                 | 12                   |

for Chrome Cobalt Milling Conditions please refer to page 209 : Hardened Steel 45 - 55 HRC in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 26).

| Work Material   |                          |                       | Stainless Steel<br>(SUS304)<br>Use water soluble coolant. |                  |                                       |  | Titanium<br>(Grade 5)<br>Side milling |                  |                                       |  |
|-----------------|--------------------------|-----------------------|---|------------------|---------------------------------------|--|---------------------------------------|------------------|---------------------------------------|--|
| Model Number    | Outside Diameter<br>(mm) | Length of Cut<br>(mm) | Spindle Speed<br>(min <sup>-1</sup> )                     | Feed<br>(mm/min) | a <sub>p</sub><br>Axial Depth<br>(mm) | a <sub>e</sub><br>Radial Depth<br>(mm) | Spindle Speed<br>(min <sup>-1</sup> ) | Feed<br>(mm/min) | a <sub>p</sub><br>Axial Depth<br>(mm) | a <sub>e</sub><br>Radial Depth<br>(mm) |
| CRRS 4020-05-06 | 2                        | 2                     | 30,000  | 7,200            | 0.04                                  | 0.66                                   | 7,960                                 | 700              | 0.04                                  | 0.66                                   |
| CRRS 4030-08-09 | 3                        | 3                     | 20,000  | 7,200            | 0.04                                  | 1.08                                   | 5,300                                 | 700              | 0.04                                  | 1.08                                   |
| CRRS 4040-05-12 | 4                        | 4                     | 15,000  | 7,200            | 0.05                                  | 1.35                                   | 4,780                                 | 750              | 0.05                                  | 1.32                                   |
| CRRS 4040-10-12 | 4                        | 4                     | 15,000  | 7,200            | 0.05                                  | 1.53                                   | 4,780                                 | 750              | 0.05                                  | 1.32                                   |
| CRRS 4050-12-15 | 5                        | 5                     | 12,000  | 7,200            | 0.06                                  | 1.80                                   | 3,820                                 | 780              | 0.06                                  | 1.8                                    |
| CRRS 4060-10-18 | 6                        | 6                     | 10,000  | 7,200            | 0.07                                  | 2.16                                   | 3,700                                 | 740              | 0.07                                  | 1.98                                   |
| CRRS 4060-15-18 | 6                        | 6                     | 10,000  | 7,200            | 0.08                                  | 2.34                                   | 3,700                                 | 740              | 0.07                                  | 1.98                                   |
| CRRS 4080-10-26 | 8                        | 8                     | 7,500   | 7,200            | 0.09                                  | 2.70                                   | 2,800                                 | 700              | 0.08                                  | 2.61                                   |
| CRRS 4080-20-24 | 8                        | 8                     | 7,500   | 7,200            | 0.10                                  | 2.79                                   | 2,800                                 | 700              | 0.08                                  | 2.61                                   |
| CRRS 4100-10-30 | 10                       | 10                    | 5,000   | 5,400            | 0.14                                  | 2.97                                   | 1,980                                 | 680              | 0.14                                  | 2.88                                   |
| CRRS 4100-20-30 | 10                       | 10                    | 5,000   | 5,400            | 0.14                                  | 3.06                                   | 1,980                                 | 680              | 0.14                                  | 2.88                                   |
| CRRS 4120-20-36 | 12                       | 12                    | 3,000   | 4,300            | 0.18                                  | 3.15                                   | 1,665                                 | 650              | 0.18                                  | 3.15                                   |

\*17 models available in total from Diameter 2mm to 12mm with various corner radius from 0.5mm to 2mm.  
For more details please ask your distributor.

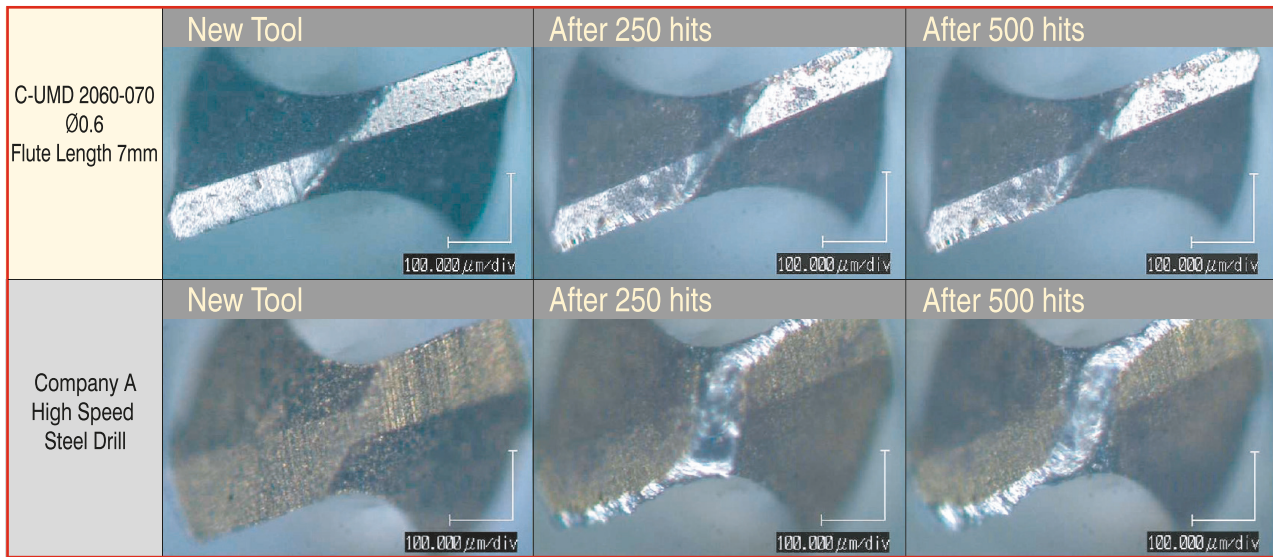
# 2 Flute

## Drilling Example 1 on Stainless Steel (SUS304)

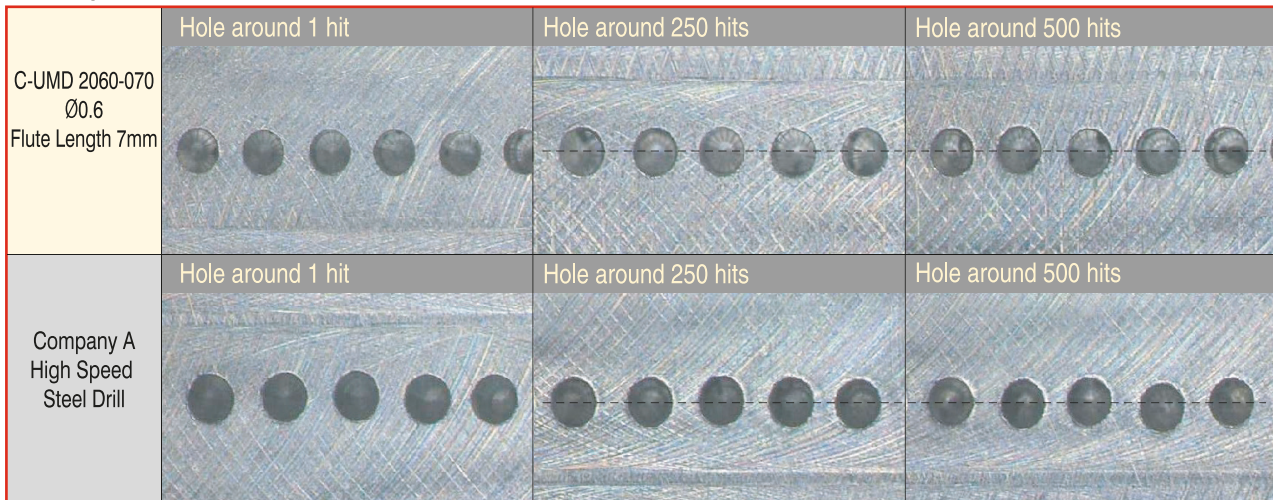
### Drilling Condition

|                |                          |                   |                                    |
|----------------|--------------------------|-------------------|------------------------------------|
| Tool:          | Ø 0.6 × Flute Length 7mm | Work Material:    | SUS304 (1.4301)                    |
| Spindle Speed: | 8,000min <sup>-1</sup>   | Overhang Length : | 10mm                               |
| Velocity:      | 15m/min                  | Coolant:          | Water Soluble Cutting Oil (Nozzle) |
| Z Feed Rate:   | 50mm/min                 | Number of Holes:  | 500 Holes                          |
| Chip Load:     | 0.00625mm/rev            | Drilling Time :   | 25 min/100 holes                   |
| Step Amount:   | 0.12 mm/time             |                   |                                    |
| Hole Depth:    | 2.4mm                    |                   |                                    |

### Comparison of Tip Damage



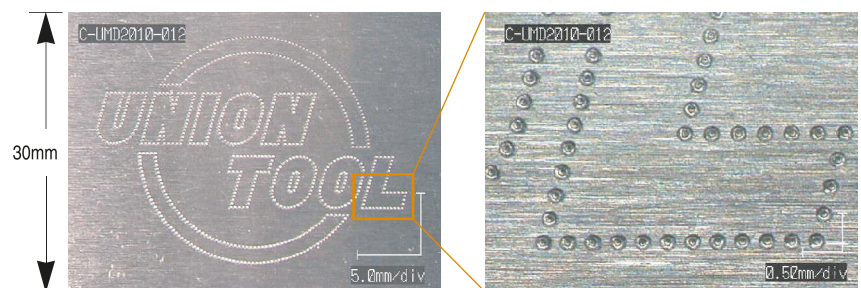
### Comparison of Hole Position



## Drilling Example 2 on Stainless Steel (SUS304)

### Drilling Condition

|                  |                      |
|------------------|----------------------|
| Tool:            | C-UMD 2010-012 Ø 0.1 |
| Work Material:   | SUS304 (1.4301)      |
| Number of Holes: | 800 holes            |



# 4 Flute

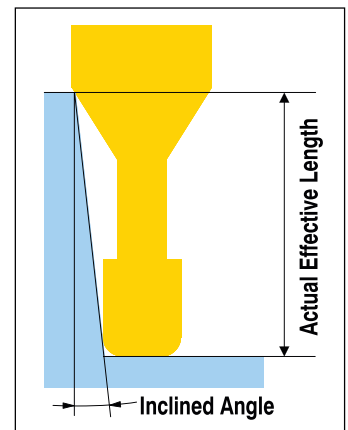
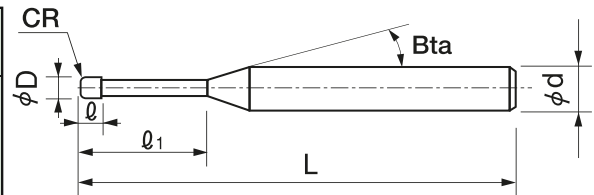
# HLRS 4000



Long Neck Radius  
Size Ø0.8 - Ø6



| Number of Flutes | Process  |                |           | Work Material   |          |               |
|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |
| 4                | ■        | ■              | ■         | ●               | ●        | ●             |



Applicable Work Material (● most suitable, ● suitable)  
Applicable Process (■ most suitable, ■ suitable)

- The 4 flutes design offers high milling efficiency and accuracy.
- The rigid tool geometry offers longer tool life.
- Suitable for both dry and wet coolant types.
- The new HARDMAX Coating ensures improved heat resistance.

Unit (mm)

| Model Number     | Outside Diameter<br>Ø D | Corner Radius<br>CR | Effective Length<br>ℓ <sub>1</sub> | Length of cut<br>ℓ | Neck Diameter<br>Ø d <sub>1</sub> | Shank Taper Angle<br>Bta | Overall Length<br>L | Shank Diameter<br>Ø d |   |  |  |  |  |  |
|------------------|-------------------------|---------------------|------------------------------------|--------------------|-----------------------------------|--------------------------|---------------------|-----------------------|---|--|--|--|--|--|
| HLRS 4008-02-020 | 0.8                     | R0.2                | 2                                  | 0.48               | 0.78                              | 16°                      | 50                  | 4                     |   |  |  |  |  |  |
| HLRS 4008-02-030 |                         |                     | 3                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4008-02-060 |                         |                     | 6                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4010-02-020 | 1.0                     | R0.2                | 2                                  | 0.8                | 0.95                              | 16°                      | 50                  | 4                     |   |  |  |  |  |  |
| HLRS 4010-02-030 |                         |                     | 3                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4010-02-050 |                         |                     | 5                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4012-02-040 | 1.2                     | R0.2                | 4                                  | 0.96               | 1.14                              | 16°                      | 50                  | 4                     |   |  |  |  |  |  |
| HLRS 4012-02-060 |                         | 6                   |                                    |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4012-03-040 |                         | R0.3                | 4                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4012-03-060 |                         |                     | 6                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4015-01-040 | 1.5                     | R0.1                | 4                                  | 1.2                | 1.45                              | 16°                      | 50                  | 4                     |   |  |  |  |  |  |
| HLRS 4015-01-060 |                         |                     | 6                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4015-01-080 |                         |                     | 8                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4015-01-100 |                         |                     | 10                                 |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4015-02-040 |                         | R0.2                | 4                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4015-02-060 |                         |                     | 6                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4015-02-080 |                         |                     | 8                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4015-02-100 |                         | 10                  |                                    |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4015-05-040 |                         | R0.5                | 4                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4015-05-060 |                         |                     | 6                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4015-05-080 | 8                       |                     |                                    |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4015-05-100 | 10                      |                     |                                    |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4020-01-060 | 2.0                     |                     | R0.1                               | 6                  | 1.6                               | 1.92                     | 16°                 | 50                    | 4 |  |  |  |  |  |
| HLRS 4020-01-080 |                         |                     |                                    | 8                  |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4020-01-100 |                         | 10                  |                                    |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4020-02-060 |                         | R0.2                | 6                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4020-02-080 |                         |                     | 8                                  |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4020-02-100 |                         |                     | 10                                 |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4020-05-060 | R0.5                    | 6                   |                                    |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4020-05-080 |                         | 8                   |                                    |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4020-05-100 |                         | 10                  |                                    |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4020-05-120 |                         | 12                  |                                    |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4025-01-060 |                         | 2.5                 | R0.1                               | 6                  | 2                                 | 2.42                     | 16°                 | 55                    | 4 |  |  |  |  |  |
| HLRS 4025-01-080 |                         |                     |                                    | 8                  |                                   |                          |                     | 50                    |   |  |  |  |  |  |
| HLRS 4025-01-100 | 10                      |                     |                                    | 50                 |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4025-01-160 | 16                      |                     |                                    | 50                 |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4025-02-060 | R0.2                    |                     |                                    | 6                  |                                   |                          |                     | 50                    |   |  |  |  |  |  |
| HLRS 4025-02-080 |                         |                     | 8                                  | 50                 |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4025-02-100 |                         |                     | 10                                 | 50                 |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4025-02-160 |                         |                     | 16                                 | 60                 |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4025-03-060 |                         |                     | R0.3                               | 6                  |                                   |                          |                     | 50                    |   |  |  |  |  |  |
| HLRS 4025-03-080 | 8                       |                     |                                    | 50                 |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4025-03-100 | 10                      | 50                  |                                    |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4025-03-160 | 16                      | 60                  |                                    |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4025-05-060 | R0.5                    | 6                   |                                    | 50                 |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4025-05-080 |                         | 8                   | 50                                 |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4025-05-100 |                         | 10                  | 50                                 |                    |                                   |                          |                     |                       |   |  |  |  |  |  |
| HLRS 4025-05-160 |                         | 16                  | 60                                 |                    |                                   |                          |                     |                       |   |  |  |  |  |  |

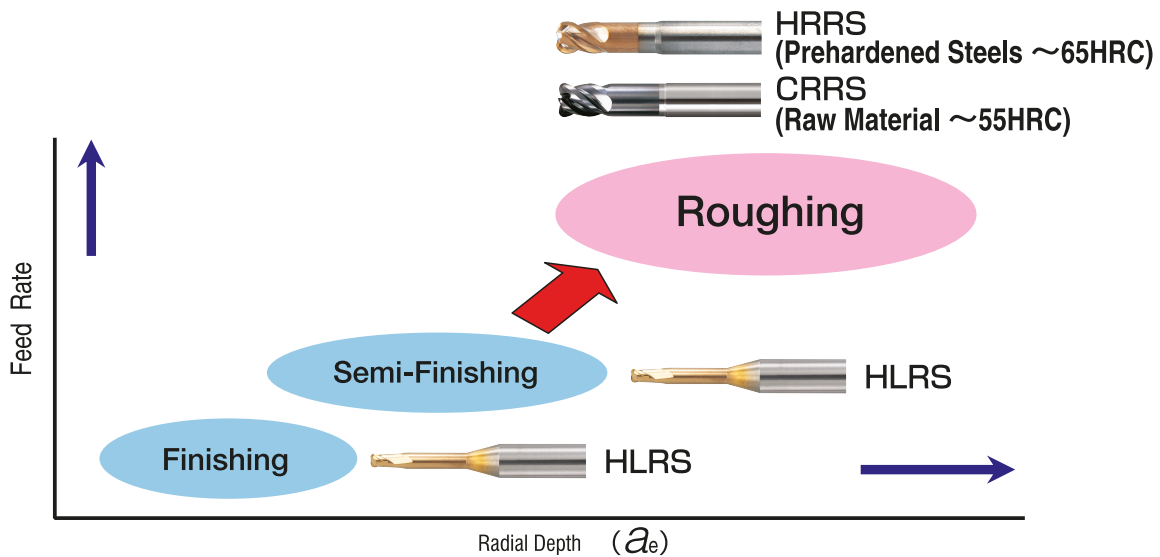
\* 219 models available in total from Diameter 0.8mm to 6mm with various corner radius from 0.05mm to 1mm.  
For more details please ask your distributor.

# 4 Flute

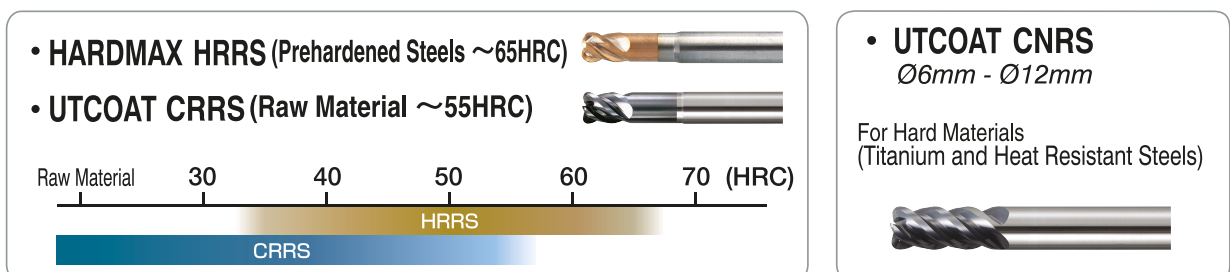
for Chrome Cobalt Milling Conditions please refer to page 200 : Hardened Steel 45 - 55 HRC in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 26).

| WORK MATERIAL |                  |                  |      | STAINLESS STEELS<br>Use a oil soluble coolant. |               |                        | TITANIUM<br>( GRADE 5 )    |               |                        | Radial Depth            |
|---------------|------------------|------------------|------|--|---------------|------------------------|----------------------------|---------------|------------------------|-------------------------|
| Model Number  | Outside Diameter | Effective Length | L/D  | Speed (min <sup>-1</sup> )                     | Feed (mm/min) | Axial Depth $a_p$ (mm) | Speed (min <sup>-1</sup> ) | Feed (mm/min) | Axial Depth $a_p$ (mm) | Radial Depth $a_e$ (mm) |
| HLRS 4008     | 0.8              | 2                | 2.5  | 20,000   | 1,100         | 0.025                  | 15,900                     | 500           | 0.015                  | 0.264                   |
|               |                  | 3                | 3.75 | 18,800   | 950           | 0.021                  | 14,000                     | 500           | 0.015                  | 0.264                   |
|               |                  | 4                | 5    | 17,500   | 840           | 0.018                  | 13,000                     | 500           | 0.010                  | 0.264                   |
| HLRS 4012     | 1.2              | 4                | 3.3  | 13,200   | 1,360         | 0.032                  | 11,900                     | 550           | 0.020                  | 0.330                   |
|               |                  | 6                | 5    | 11,200   | 1,160         | 0.028                  | 11,000                     | 550           | 0.020                  | 0.330                   |
| HLRS 4015     | 1.5              | 4                | 2.7  | 13,200   | 1,360         | 0.054                  | 9,600                      | 550           | 0.030                  | 0.0495                  |
|               |                  | 6                | 4    | 11,600   | 1,280         | 0.041                  | 9,000                      | 600           | 0.030                  | 0.495                   |
|               |                  | 8                | 5.3  | 10,200   | 1,080         | 0.037                  | 8,500                      | 600           | 0.025                  | 0.495                   |
|               |                  | 10               | 6.7  | 9,300  | 930           | 0.032                  | 8,000                      | 550           | 0.025                  | 0.495                   |
| HLRS 4020     | 2                | 8                | 4    | 11,200   | 1,160         | 0.058                  | 8,000                      | 700           | 0.040                  | 0.660                   |
|               |                  | 10               | 5    | 10,000   | 1,090         | 0.049                  | 7,500                      | 650           | 0.040                  | 0.660                   |
|               |                  | 12               | 6    | 9,100  | 1,030         | 0.046                  | 7,000                      | 600           | 0.035                  | 0.660                   |
| HLRS 4025     | 2.5              | 8                | 3.2  | 11,300   | 1,430         | 0.075                  | 6,400                      | 700           | 0.040                  | 0.825                   |
|               |                  | 10               | 4    | 10,500   | 1,400         | 0.067                  | 6,000                      | 650           | 0.040                  | 0.825                   |
|               |                  | 16               | 6.4  | 8,900  | 1,400         | 0.059                  | 5,600                      | 600           | 0.040                  | 0.825                   |

## Usage of Radius Series



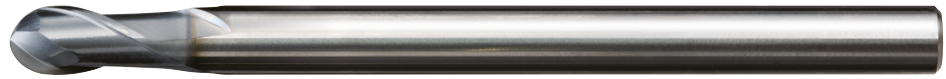
## 4 Flutes Active Corner Radius End Mill's Target Hardness



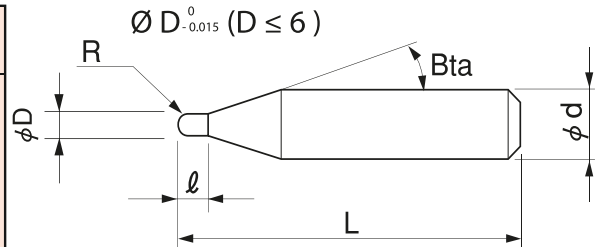
# 2 Flute

# CSEB

Ball  
Size R0.05 - R6



| Number of Flutes | Process  |                |           | Work Material   |          |               |
|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |
| 2                | ■        | ■              | ■         | ●               | ●        | ●             |



Applicable Work Material (● most suitable, ● suitable)  
Applicable Process (■ most suitable, ■ suitable)

New robust geometry offers durability when roughing, yet gives excellent surface quality for finishing.  
The new multi-layered UTCOAT resists wear though improved hardness, durability and coating adhesion to the tool.  
Broad application range from raw material to titanium.

Unit (mm)

| Model Number     | Radius of Ball Nose R | Length of Cut ℓ | Shank Taper Angle Bta | Overall Length L | Shank Diameter Ø d |
|------------------|-----------------------|-----------------|-----------------------|------------------|--------------------|
| CSEB 2002-0020-6 | R0.1                  | 0.2             | 11°                   | 50               | 6                  |
| CSEB 2002-0030   | R0.1                  | 0.3             | 11°                   | 50               | 4                  |
| CSEB 2003-0030   | R0.15                 | 0.3             | 11°                   | 50               | 4                  |
| CSEB 2003-0030-6 | R0.15                 | 0.3             | 11°                   | 50               | 6                  |
| CSEB 2003-0045   | R0.15                 | 0.45            | 11°                   | 50               | 4                  |
| CSEB 2004-0040   | R0.2                  | 0.4             | 11°                   | 50               | 4                  |
| CSEB 2004-0040-6 | R0.2                  | 0.4             | 11°                   | 50               | 6                  |
| CSEB 2004-0060   | R0.2                  | 0.6             | 11°                   | 50               | 4                  |
| CSEB 2005-0050   | R0.25                 | 0.5             | 11°                   | 50               | 4                  |
| CSEB 2005-0050-6 | R0.25                 | 0.5             | 11°                   | 50               | 6                  |
| CSEB 2005-0075   | R0.25                 | 0.75            | 11°                   | 50               | 4                  |

for Chrome Cobalt Milling Conditions please refer to page 234 : Hardened Steel 45 - 55 HRC in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 27).

| Work Material    |                          |               | Stainless Steel (SUS304)<br>Use oil soluble coolant. |               |                  |                   | TITANIUM (Grade 5)                 |               |                  |                   |
|------------------|--------------------------|---------------|--|---------------|------------------|-------------------|------------------------------------|---------------|------------------|-------------------|
| Model Number     | Radius of Ball Nose (mm) | Length of Cut | Spindle Speed (min <sup>-1</sup> )                   | Feed (mm/min) | axial Depth (mm) | Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed (mm/min) | axial Depth (mm) | Radial Depth (mm) |
| CSEB 2002-0020-6 | R0.1                     | 0.2           | 60,000   | 250           | 0.008            | 0.024             | 60,000                             | 250           | 0.008            | 0.024             |
| CSEB 2002-0030   | R0.1                     | 0.3           | 60,000   | 250           | 0.008            | 0.024             | 60,000                             | 250           | 0.008            | 0.024             |
| CSEB 2003-0030   | R0.15                    | 0.3           | 54,000   | 350           | 0.012            | 0.024             | 54,000                             | 350           | 0.012            | 0.024             |
| CSEB 2003-0030-6 | R0.15                    | 0.3           | 54,000   | 350           | 0.012            | 0.024             | 54,000                             | 350           | 0.012            | 0.024             |
| CSEB 2003-0045   | R0.15                    | 0.45          | 54,000   | 350           | 0.012            | 0.024             | 54,000                             | 350           | 0.012            | 0.024             |
| CSEB 2004-0040   | R0.2                     | 0.4           | 50,000   | 550           | 0.020            | 0.040             | 50,000                             | 550           | 0.020            | 0.040             |
| CSEB 2004-0040-6 | R0.2                     | 0.4           | 50,000   | 550           | 0.020            | 0.040             | 50,000                             | 550           | 0.020            | 0.040             |
| CSEB 2004-0060   | R0.2                     | 0.6           | 50,000   | 550           | 0.020            | 0.040             | 50,000                             | 550           | 0.020            | 0.040             |
| CSEB 2005-0050   | R0.25                    | 0.5           | 45,000   | 750           | 0.030            | 0.060             | 45,000                             | 750           | 0.030            | 0.060             |
| CSEB 2005-0050-6 | R0.25                    | 0.5           | 40,000   | 750           | 0.030            | 0.060             | 40,000                             | 750           | 0.030            | 0.060             |
| CSEB 2005-0075   | R0.25                    | 0.75          | 40,000   | 750           | 0.030            | 0.060             | 40,000                             | 750           | 0.030            | 0.060             |

\* 77 models available in total from Radius R0.05 mm to R6 mm.  
For more details please ask your distributor.



# 3 Flute

## CFB

Ball  
Size R0.3 - R6

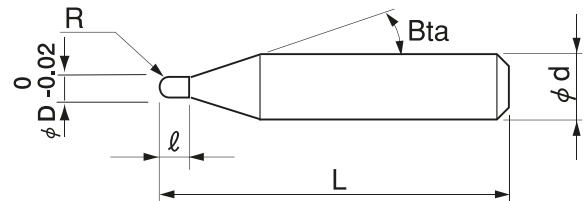


R1 - R1.5

R2 - R3

R4 - R6

| Number of Flutes | Process  |                |           | Work Material   |          |               |
|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |
| 3                | ■        | ■              | ■         | ●               | ●        | ●             |



Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)

3 flutes design offers high feed milling, reducing cycle times when roughing.

Capable of deep milling that raises machine efficiency, even with complicated shapes that require slow feeds.

Variable pitch design minimizes tool chattering.

The original design features help to promote excellent chip evacuation and surface finishing on tools that are 0.75mm and larger. Diameter tolerance : 0 / -0.02mm.

Unit (mm)

| Model Number  | Radius of Ball Nose<br>R | Length of Cut<br>l | Shank Taper Angle<br>Bta | Overall Length<br>L | Shank Diameter<br>Ø d |
|---------------|--------------------------|--------------------|--------------------------|---------------------|-----------------------|
| CFB 3006-0090 | R0.3                     | 0.9                | 16°                      | 50                  | 4                     |
| CFB 3008-0120 | R0.4                     | 1.2                | 16°                      | 50                  | 4                     |
| CFB 3010-0150 | R0.5                     | 1.5                | 16°                      | 50                  | 4                     |
| CFB 3015-0225 | R0.75                    | 2.25               | 16°                      | 50                  | 4                     |
| CFB 3020-0300 | R1                       | 3                  | 16°                      | 50                  | 4                     |
| CFB 3030-0450 | R1.5                     | 4.5                | 16°                      | 60                  | 6                     |
| CFB 3040-0600 | R2                       | 6                  | 16°                      | 70                  | 6                     |
| CFB 3050-0750 | R2.5                     | 7.5                | 16°                      | 80                  | 6                     |
| CFB 3060-0900 | R3                       | 9                  | -                        | 80                  | 6                     |
| CFB 3080-1200 | R4                       | 12                 | -                        | 90                  | 8                     |
| CFB 3100-1500 | R5                       | 15                 | -                        | 100                 | 10                    |
| CFB 3120-1800 | R6                       | 18                 | -                        | 110                 | 12                    |

for Chrome Cobalt Milling Conditions please refer to page 241 : Hardened Steel 45 - 55 HRC in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 27).

| Model Number  | Work Material               |                       | Stainless Steel<br>(SUS304)<br><small>Use water soluble coolant.</small> |                  |                                       |  | Titanium<br>(Grade 5)                 |                  |                                       |  |
|---------------|-----------------------------|-----------------------|--|------------------|---------------------------------------|--|---------------------------------------|------------------|---------------------------------------|--|
|               | Radius of Ball Nose<br>(mm) | Length of Cut<br>(mm) | Spindle Speed<br>(min <sup>-1</sup> )                                    | Feed<br>(mm/min) | a <sub>p</sub><br>Axial Depth<br>(mm) | a <sub>e</sub><br>Radial Depth<br>(mm) | Spindle Speed<br>(min <sup>-1</sup> ) | Feed<br>(mm/min) | a <sub>p</sub><br>Axial Depth<br>(mm) | a <sub>e</sub><br>Radial Depth<br>(mm) |
| CFB 3006-0090 | R0.3                        | 0.9                   | 20,000   | 1,000            | 0.015                                 | 0.09                                   | 20,000                                | 1,000            | 0.015                                 | 0.09                                   |
| CFB 3008-0120 | R0.4                        | 1.2                   | 20,000   | 1,250            | 0.02                                  | 0.12                                   | 20,000                                | 1,250            | 0.02                                  | 0.12                                   |
| CFB 3010-0150 | R0.5                        | 1.5                   | 20,000   | 1,500            | 0.025                                 | 0.15                                   | 20,000                                | 1,500            | 0.025                                 | 0.15                                   |
| CFB 3015-0225 | R0.75                       | 2.25                  | 20,000   | 2,500            | 0.035                                 | 0.22                                   | 20,000                                | 2,500            | 0.035                                 | 0.22                                   |
| CFB 3020-0300 | R1                          | 3                     | 24,000   | 4,000            | 0.1                                   | 0.4                                    | 24,000                                | 4,000            | 0.1                                   | 0.4                                    |
| CFB 3030-0450 | R1.5                        | 4.5                   | 16,000   | 4,000            | 0.15                                  | 0.65                                   | 16,000                                | 4,000            | 0.15                                  | 0.65                                   |
| CFB 3040-0600 | R2                          | 6                     | 12,000   | 4,000            | 0.2                                   | 0.85                                   | 12,000                                | 4,000            | 0.2                                   | 0.85                                   |
| CFB 3050-0750 | R2.5                        | 7.5                   | 10,000   | 4,000            | 0.25                                  | 1                                      | 10,000                                | 4,000            | 0.25                                  | 1                                      |
| CFB 3060-0900 | R3                          | 9                     | 8,000  | 4,000            | 0.3                                   | 1.3                                    | 8,000                                 | 4,000            | 0.3                                   | 1.3                                    |
| CFB 3080-1200 | R4                          | 12                    | 6,000  | 4,000            | 0.4                                   | 1.7                                    | 6,000                                 | 4,000            | 0.4                                   | 1.7                                    |
| CFB 3100-1500 | R5                          | 15                    | 4,800  | 4,000            | 0.5                                   | 2.1                                    | 4,800                                 | 4,000            | 0.5                                   | 2.1                                    |
| CFB 3120-1800 | R6                          | 18                    | 4,000  | 4,000            | 0.6                                   | 2.6                                    | 4,000                                 | 4,000            | 0.6                                   | 2.6                                    |

\*14 models available in total from Radius 0.3 mm to 6mm.  
For more details please ask your distributor.

# 4 Flute

## HFB-S

Short Ball  
Size R1 - R6



R1 - R1.5

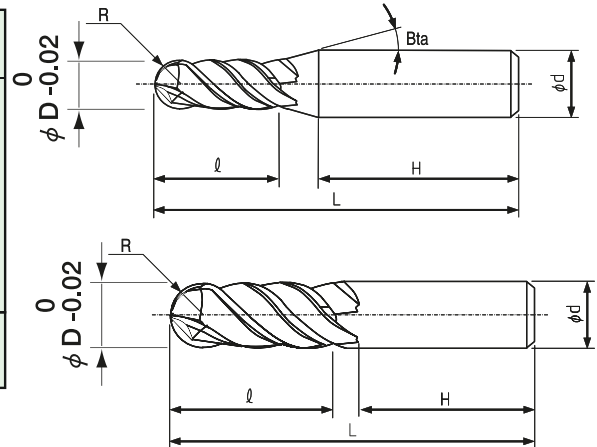
R2 - R3

R4 - R6

| Number of Flutes | Process  |                |           | Work Material   |          |               |
|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |
| 4                | ■        | ■              | ■         | ●               | ●        | ●             |

Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)



The tool geometry offers outstanding chip evacuation performance.

The new tip design offers excellent cutting performance.

Offers excellent tool performance to cost ratio.

Diameter Tolerance : 0/ -0.02mm

Unit (mm)

| Model Number   | Radius of Ball Nose<br>R | Length of Cut<br>$l$ | Shank Taper Angle<br>Bta | Overall Length<br>L | Shank Diameter<br>$\varnothing d$ |
|----------------|--------------------------|----------------------|--------------------------|---------------------|-----------------------------------|
| HFB 4020-0300S | R1                       | 3                    | 16°                      | 40                  | 4                                 |
| HFB 4030-0450S | R1.5                     | 4.5                  | 16°                      | 40                  | 4                                 |
| HFB 4040-0600S | R2                       | 6                    | 16°                      | 45                  | 6                                 |
| HFB 4060-0900S | R3                       | 9                    | -                        | 50                  | 6                                 |
| HFB 4080-1200S | R4                       | 12                   | -                        | 60                  | 8                                 |
| HFB 4100-1500S | R5                       | 15                   | -                        | 60                  | 10                                |
| HFB 4120-1800S | R6                       | 18                   | -                        | 60                  | 12                                |

for Chrome Cobalt Milling Conditions please refer to page 248 : Hardened Steel 45 - 55 HRC in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 27).

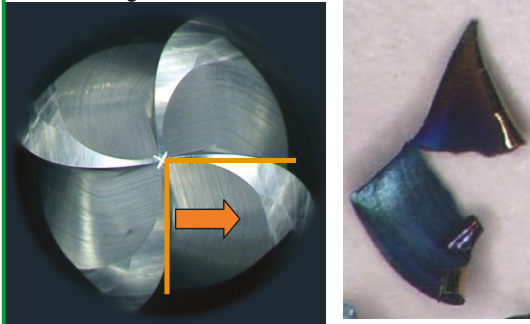
| Work Material  | Stainless Steel<br>(SUS304)<br>Use water soluble coolant. |                          |                    |                                    |               |                        | Titanium<br>(Grade 5)<br>Use air blow. |                                    |             |                        |
|----------------|---|--------------------------|--------------------|------------------------------------|---------------|------------------------|--|------------------------------------|-------------|------------------------|
|                | Model Number  | Radius of Ball Nose (mm) | Length of Cut (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm)                | Spindle Speed (min <sup>-1</sup> ) | Feed mm/min | $a_p$ Axial Depth (mm) |
| HFB 4020-0300S | R1  | 3                        | 24,000             | 4,000                              | 0.20          | 0.60                   | 24,000                                 | 4,000                              | 0.20        | 0.60                   |
| HFB 4030-0450S | R1.5  | 4.5                      | 16,000             | 4,000                              | 0.30          | 0.90                   | 16,000                                 | 4,000                              | 0.30        | 0.90                   |
| HFB 4040-0600S | R2  | 6                        | 12,000             | 4,000                              | 0.40          | 1.20                   | 12,000                                 | 4,000                              | 0.40        | 1.20                   |
| HFB 4060-0900S | R3  | 9                        | 8,000              | 4,000                              | 0.60          | 1.80                   | 8,000                                  | 4,000                              | 0.60        | 1.80                   |
| HFB 4080-1200S | R4  | 12                       | 6,000              | 4,000                              | 0.80          | 2.40                   | 6,000                                  | 4,000                              | 0.80        | 2.40                   |
| HFB 4100-1500S | R5  | 15                       | 4,800              | 4,000                              | 1.00          | 3.00                   | 4,800                                  | 4,000                              | 1.00        | 3.00                   |
| HFB 4120-1800S | R6  | 18                       | 4,000              | 4,000                              | 1.20          | 3.60                   | 4,000                                  | 4,000                              | 1.20        | 3.60                   |

\* 7 models available in total from Radius 1mm to 6mm.  
For more details please ask your distributor.

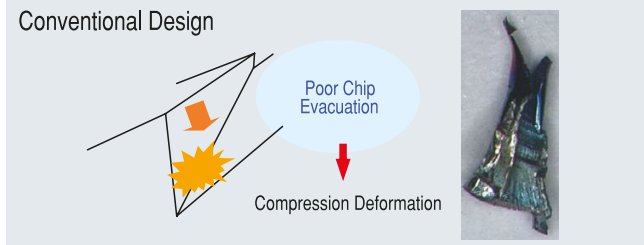
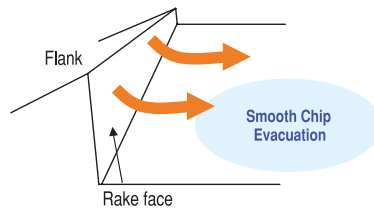
# 4 Flute

## Feature 1 Special Design Achieves Outstanding Chip Evacuation

### HFB Design



Flat (Non-rolled up) chip shape helps smooth chip evacuation.



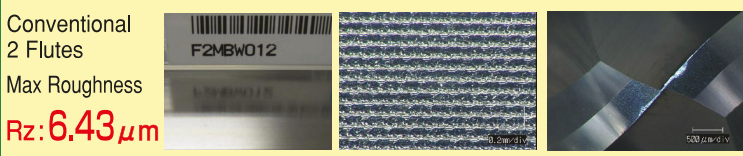
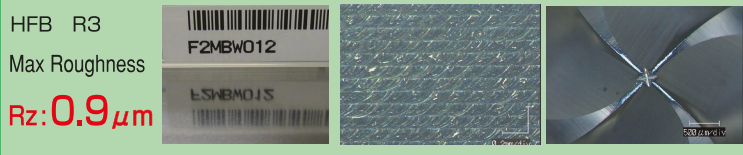
|                 | HFB | Competitor A | Competitor B |
|-----------------|-----|--------------|--------------|
| Tip Point       |     |              |              |
| Milling Surface |     |              |              |
| Chip Condition  |     |              |              |

|                    |                                       |
|--------------------|---------------------------------------|
| Tool               | R2                                    |
| Work Material      | YXR33 (58HRC)                         |
| Spindle Speed      | 6,000min <sup>-1</sup>                |
| Feed Rate          | 2,400mm/min<br>(Slotting:1,200mm/min) |
| Axial Depth $a_p$  | 1mm (0.25D)<br>D: Outside Diameter    |
| Radial Depth $a_e$ | 1mm (0.25D)<br>D: Outside Diameter    |
| Overhang           | 15mm                                  |
| Coolant            | Air Blow (Through Spindle)            |
| Pocket Size        | 100mmx20mmx6mm(X×Y×Z)                 |
| Cycle Time         | 28.2min                               |

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 Surface Finish Performance

### STAVAX (53HRC) Milling Example: Surface Finishing HFB (R3)

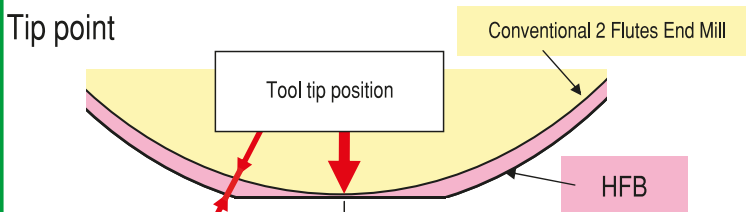


|                    |                         |
|--------------------|-------------------------|
| Spindle Speed      | 12,800min <sup>-1</sup> |
| Feed Rate          | 2,500mm/min             |
| Axial Depth $a_p$  | 0.06mm(0.01D)           |
| Radial Depth $a_e$ | 0.12mm(0.02D)           |
| Coolant            | Oil Mist                |

4 grooves on the tip point help surface finishing process. Max roughness value was 0.9μm on 1hour testing.

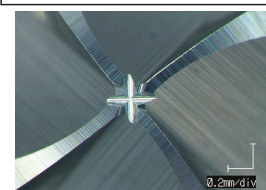
The tool condition is better than conventional 2 Flutes.

### Tip point



| Radius  | Max R tolerance error point | HFB R Tolerance |
|---------|-----------------------------|-----------------|
| R2 · R3 | under +5μm                  | ±7μm            |
| R4 · R5 | under +7μm                  | ±10μm           |
| R6      | under +10μm                 |                 |

### 4 Tip Point Grooves



4 tip point groove can achieve longer tool life.

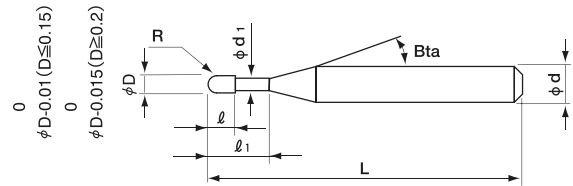
# 2 Flute

# CSELB

Long Neck Ball  
Size R0.05 - R3



| Number of Flutes | Process  |                |           | Work Material   |          |               |
|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |
| 2                | ■        | ■              | ■         | ●               | ●        | ●             |



Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)

New robust geometry offers durability when roughing, yet gives excellent surface quality for finishing.

The new multi layered UTCOAT resists wear though improved hardness, durability and coating adhesion to the tool.

Broad application range from raw materials to Titanium.

Unit (mm)

| Model Number    | Radius of Ball Nose R | Effective Length $l_1$ | Length of Cut $l$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ |
|-----------------|-----------------------|------------------------|-------------------|-----------------------|------------------|-------------------------|
| CSELB 2002-005  | R0.1                  | 0.5                    | 0.16              | 11°                   | 45               | 4                       |
| CSELB 2002-0075 | R0.1                  | 0.75                   | 0.16              | 11°                   | 45               | 4                       |
| CSELB 2002-010  | R0.1                  | 1.0                    | 0.16              | 11°                   | 45               | 4                       |
| CSELB 2003-0075 | R0.15                 | 0.75                   | 0.24              | 11°                   | 45               | 4                       |
| CSELB 2003-010  | R0.15                 | 1                      | 0.24              | 11°                   | 45               | 4                       |
| CSELB 2003-015  | R0.15                 | 1.5                    | 0.24              | 11°                   | 45               | 4                       |
| CSELB 2004-010  | R0.2                  | 1                      | 0.32              | 11°                   | 45               | 4                       |
| CSELB 2004-015  | R0.2                  | 1.5                    | 0.32              | 11°                   | 45               | 4                       |
| CSELB 2004-020  | R0.2                  | 2                      | 0.32              | 11°                   | 45               | 4                       |
| CSELB 2005-015  | R0.25                 | 1.5                    | 0.4               | 11°                   | 45               | 4                       |
| CSELB 2005-020  | R0.25                 | 2                      | 0.4               | 11°                   | 45               | 4                       |
| CSELB 2005-025  | R0.25                 | 2.5                    | 0.4               | 11°                   | 45               | 4                       |

for Chrome Cobalt Milling Conditions please refer to page 302 : Hardened Steel 45 - 55 HRC in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 27).

| Model Number    | Work Material            |                       | Stainless Steel (SUS304)<br>Use oil coolant. |               |                        |                         | Titanium (Grade 5)                 |               |                        |                         |
|-----------------|--------------------------|-----------------------|--|---------------|------------------------|-------------------------|------------------------------------|---------------|------------------------|-------------------------|
|                 | Radius of Ball Nose (mm) | Effective Length (mm) | Spindle Speed (min <sup>-1</sup> )           | Feed (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) | Spindle Speed (min <sup>-1</sup> ) | Feed (mm/min) | $a_p$ Axial Depth (mm) | $a_e$ Radial Depth (mm) |
| CSELB 2002-005  | R0.1                     | 0.5                   | 60,000                                       | 250           | 0.008                  | 0.016                   | 60,000                             | 250           | 0.008                  | 0.016                   |
| CSELB 2002-0075 | R0.1                     | 0.75                  | 60,000                                       | 220           | 0.007                  | 0.015                   | 60,000                             | 220           | 0.007                  | 0.015                   |
| CSELB 2002-010  | R0.1                     | 1                     | 60,000                                       | 200           | 0.005                  | 0.015                   | 60,000                             | 200           | 0.005                  | 0.015                   |
| CSELB 2003-0075 | R0.15                    | 0.75                  | 43,000                                       | 400           | 0.012                  | 0.024                   | 43,000                             | 400           | 0.012                  | 0.024                   |
| CSELB 2003-010  | R0.15                    | 1                     | 43,000                                       | 350           | 0.008                  | 0.024                   | 43,000                             | 350           | 0.008                  | 0.024                   |
| CSELB 2003-015  | R0.15                    | 0.5                   | 43,000                                       | 300           | 0.007                  | 0.021                   | 43,000                             | 300           | 0.007                  | 0.021                   |
| CSELB 2004-010  | R0.2                     | 1                     | 35,000                                       | 1,000         | 0.02                   | 0.04                    | 35,000                             | 1,000         | 0.02                   | 0.04                    |
| CSELB 2004-015  | R0.2                     | 1.5                   | 35,000                                       | 700           | 0.016                  | 0.033                   | 35,000                             | 700           | 0.016                  | 0.033                   |
| CSELB 2004-020  | R0.2                     | 2                     | 35,000                                       | 500           | 0.011                  | 0.033                   | 35,000                             | 500           | 0.011                  | 0.033                   |
| CSELB 2005-015  | R0.25                    | 1.5                   | 34,000                                       | 900           | 0.025                  | 0.05                    | 34,000                             | 900           | 0.025                  | 0.05                    |
| CSELB 2005-020  | R0.25                    | 2                     | 34,000                                       | 700           | 0.23                   | 0.046                   | 34,000                             | 700           | 0.23                   | 0.046                   |
| CSELB 2005-025  | R0.25                    | 2.5                   | 34,000                                       | 600           | 0.015                  | 0.045                   | 34,000                             | 600           | 0.015                  | 0.045                   |

\* 165 models available in total from Radius R0.05mm to R3 mm with effective length from 4 to 30 X diameter.  
For more details please ask your distributor.

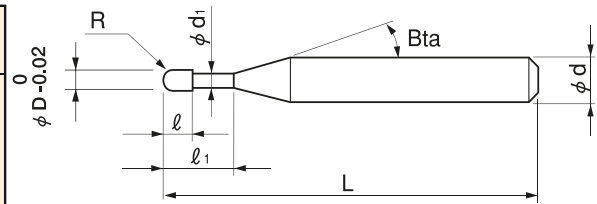
# 3 Flute

## CFLB

Long Neck Ball  
Size R0.3 - R3



| Number of Flutes | Process  |               |        | Work Material   |          |               |
|------------------|----------|---------------|--------|-----------------|----------|---------------|
|                  | Roughing | Semi - Finish | Finish | Stainless Steel | Titanium | Chrome Cobalt |
| 3                | ■        | ■             | ■      | ●               | ●        | ●             |



Applicable Work Material (● most suitable, ● suitable)  
Applicable Process (■ most suitable, ■ suitable)

3 flute design offers higher feed rate milling, reducing cycle times when roughing.

Capable of deep milling that raises machine efficiency, even with complicated shape that require slow feeds.

Variable pitch design minimizes tool chattering.

The original design features help to promote excellent chip evacuation and surface finishing on tools that are R0.75mm and larger. Diameter tolerance : 0 / -0.02mm.

| Model Number  | Radius of Ball Nose R | Effective Length of cut $l_1$ | Length of cut $l$ | Shank Taper Angle Bta | Overall Length L | Shank Diameter $\phi d$ |
|---------------|-----------------------|-------------------------------|-------------------|-----------------------|------------------|-------------------------|
| CFLB 3006-020 | R0.3                  | 2                             | 0.48              | 16°                   | 50               | 4                       |
| CFLB 3006-030 | R0.3                  | 3                             | 0.48              | 16°                   | 50               | 4                       |
| CFLB 3010-025 | R0.5                  | 2.5                           | 0.8               | 16°                   | 50               | 4                       |
| CFLB 3010-030 | R0.5                  | 3                             | 0.8               | 16°                   | 50               | 4                       |
| CFLB 3010-040 | R0.5                  | 4                             | 0.8               | 16°                   | 50               | 4                       |
| CFLB 3015-060 | R0.75                 | 6                             | 1.2               | 16°                   | 50               | 4                       |
| CFLB 3015-080 | R0.75                 | 8                             | 1.2               | 16°                   | 50               | 4                       |
| CFLB 3015-100 | R0.75                 | 10                            | 1.2               | 16°                   | 50               | 4                       |
| CFLB 3020-060 | R1                    | 6                             | 1.6               | 16°                   | 50               | 4                       |
| CFLB 3020-080 | R1                    | 8                             | 1.6               | 16°                   | 50               | 4                       |
| CFLB 3020-100 | R1                    | 10                            | 1.6               | 16°                   | 50               | 4                       |
| CFLB 3030-080 | R1.5                  | 8                             | 2.4               | 16°                   | 60               | 6                       |
| CFLB 3030-100 | R1.5                  | 10                            | 2.4               | 16°                   | 60               | 6                       |
| CFLB 3030-120 | R1.5                  | 12                            | 2.4               | 16°                   | 60               | 6                       |
| CFLB 3040-120 | R2                    | 12                            | 3.2               | 16°                   | 70               | 6                       |
| CFLB 3040-160 | R2                    | 16                            | 3.2               | 16°                   | 70               | 6                       |
| CFLB 3040-200 | R2                    | 20                            | 3.2               | 16°                   | 70               | 6                       |

for Chrome Cobalt Milling Conditions please refer to page 322 : Titanium in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 27).

| Model Number  | Work Material            |                       |                                    | Stainless Steel (SUS304)<br>Use water soluble coolant. |                        |                         | Titanium (Grade 5)                 |                    |                        |                         |
|---------------|--------------------------|-----------------------|------------------------------------|--|------------------------|-------------------------|------------------------------------|--------------------|------------------------|-------------------------|
|               | 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) |
| CFLB 3006-020 | R0.3                     | 2                     | 20,000                             | 1,000  | 0.015                  | 0.09                    | 20,000                             | 1,000              | 0.015                  | 0.09                    |
| CFLB 3006-030 | R0.3                     | 3                     | 20,000                             | 1,000  | 0.015                  | 0.09                    | 20,000                             | 1,000              | 0.015                  | 0.09                    |
| CFLB 3010-025 | R0.5                     | 2.5                   | 20,000                             | 500  | 0.025                  | 0.15                    | 20,000                             | 500                | 0.025                  | 0.15                    |
| CFLB 3010-030 | R0.5                     | 3                     | 20,000                             | 1,500  | 0.025                  | 0.15                    | 20,000                             | 1,500              | 0.025                  | 0.15                    |
| CFLB 3010-040 | R0.5                     | 4                     | 20,000                             | 1,500  | 0.025                  | 0.15                    | 20,000                             | 1,500              | 0.025                  | 0.15                    |
| CFLB 3015-060 | R0.75                    | 6                     | 20,000                             | 2,500  | 0.035                  | 0.22                    | 20,000                             | 2,500              | 0.035                  | 0.22                    |
| CFLB 3015-080 | R0.75                    | 8                     | 20,000                             | 2,500  | 0.035                  | 0.22                    | 20,000                             | 2,500              | 0.035                  | 0.22                    |
| CFLB 3015-100 | R0.75                    | 10                    | 16,000                             | 2,000  | 0.025                  | 0.19                    | 16,000                             | 2,000              | 0.025                  | 0.19                    |
| CFLB 3020-060 | R1                       | 6                     | 20,000                             | 3,200  | 0.100                  | 0.43                    | 20,000                             | 3,200              | 0.100                  | 0.43                    |
| CFLB 3020-080 | R1                       | 8                     | 20,000                             | 3,000  | 0.100                  | 0.43                    | 20,000                             | 3,000              | 0.100                  | 0.43                    |
| CFLB 3020-100 | R1                       | 10                    | 20,000                             | 4,000  | 0.100                  | 0.43                    | 20,000                             | 4,000              | 0.100                  | 0.43                    |
| CFLB 3030-080 | R1.5                     | 8                     | 16,000                             | 4,000  | 0.150                  | 0.65                    | 16,000                             | 4,000              | 0.150                  | 0.65                    |
| CFLB 3030-100 | R1.5                     | 10                    | 16,000                             | 3,600  | 0.150                  | 0.65                    | 16,000                             | 3,600              | 0.150                  | 0.65                    |
| CFLB 3030-120 | R1.5                     | 12                    | 16,000                             | 4,000  | 0.135                  | 0.65                    | 16,000                             | 4,000              | 0.135                  | 0.65                    |
| CFLB 3040-120 | R2                       | 12                    | 12,000                             | 3,600  | 0.200                  | 0.87                    | 12,000                             | 3,600              | 0.200                  | 0.87                    |
| CFLB 3040-160 | R2                       | 16                    | 10,800                             | 3,000  | 0.200                  | 0.87                    | 10,800                             | 3,000              | 0.200                  | 0.87                    |
| CFLB 3040-200 | R2                       | 20                    | 9,000                              |  | 0.200                  | 0.87                    | 9,000                              |                    | 0.200                  | 0.87                    |

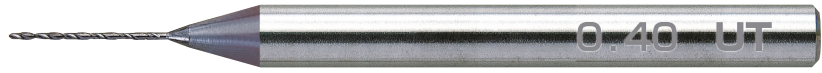
\*More models available, 32 models in total from Radius R0.3 mm to R3 mm with effective length from 5 to 15 X diameter.  
For more details please ask your distributor.

# 2 Flute

## C-UMD

Drill

Size  $\emptyset 0.1 - \emptyset 3$

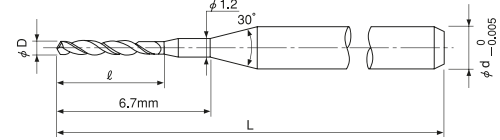


| Number of Flutes | Process  |                |           | Work Material   |          |               |
|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |
| 2                |          |                |           | ●               | ●        |               |

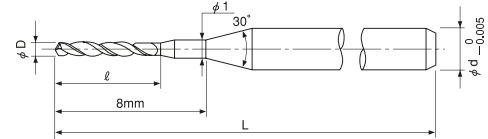
Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)

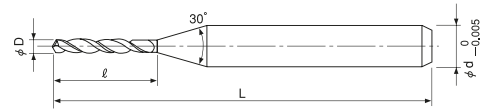
■  $\phi 0.1 \sim \phi 0.25$



■  $\phi 0.26 \sim \phi 0.65$



■  $\phi 0.66 \sim \phi 3$



Diameter tolerance :  $\emptyset D \leq 3$  :  $\emptyset D \begin{smallmatrix} 0 \\ -0.01 \end{smallmatrix}$

Point Angle :  $150^\circ$

225 models available: from  $\emptyset 0.1$  mm to  $\emptyset 3$  mm by increments of 0.01mm

Unit (mm)

| Model Number   | Diameter $\emptyset D$ | Flute Length $\phi$ | Overall Length L | Shank Diameter $\emptyset d$ |
|----------------|------------------------|---------------------|------------------|------------------------------|
| C-UMD 2010-012 | 0.1                    | 1.2                 | 38               | 3                            |
| C-UMD 2011-012 | 0.11                   | 1.2                 | 38               | 3                            |
| C-UMD 2012-014 | 0.12                   | 1.4                 | 38               | 3                            |
| C-UMD 2014-014 | 0.14                   | 1.4                 | 38               | 3                            |
| C-UMD 2015-020 | 0.15                   | 2                   | 38               | 3                            |
| C-UMD 2019-020 | 0.19                   | 2                   | 38               | 3                            |
| C-UMD 2020-025 | 0.20                   | 2.5                 | 38               | 3                            |
| C-UMD 2024-025 | 0.24                   | 2.5                 | 38               | 3                            |
| C-UMD 2025-030 | 0.25                   | 3                   | 38               | 3                            |
| C-UMD 2029-030 | 0.29                   | 3                   | 38               | 3                            |
| C-UMD 2030-050 | 0.30                   | 5                   | 38               | 3                            |
| C-UMD 2034-050 | 0.34                   | 5                   | 38               | 3                            |
| C-UMD 2035-060 | 0.35                   | 6                   | 38               | 3                            |
| C-UMD 2039-060 | 0.39                   | 6                   | 38               | 3                            |
| C-UMD 2040-070 | 0.40                   | 7                   | 38               | 3                            |
| C-UMD 2069-070 | 0.69                   | 7                   | 38               | 3                            |
| C-UMD 2070-080 | 0.70                   | 8                   | 38               | 3                            |
| C-UMD 2079-080 | 0.79                   | 8                   | 38               | 3                            |
| C-UMD 2080-100 | 0.80                   | 10                  | 38               | 3                            |
| C-UMD 2159-100 | 1.59                   | 10                  | 38               | 3                            |
| C-UMD 2160-120 | 1.60                   | 12                  | 38               | 3                            |
| C-UMD 2300-120 | 3.00                   | 12                  | 38               | 3                            |

| Work Material   |                              | Stainless Steel (SUS304)<br>Use water soluble coolant |               |                  | Titanium (Grade 5)<br>Use oil coolant. |               |                  |
|-----------------|------------------------------|---|---------------|------------------|--|---------------|------------------|
| Diameter (mm)   | Recommended Step Amount (mm) | Spindle Speed (min <sup>-1</sup> )                    | Feed (mm/min) | Velocity (m/min) | Spindle Speed (min <sup>-1</sup> )     | Feed (mm/min) | Velocity (m/min) |
| $\emptyset 0.3$ | 0.1 - 0.2 $\emptyset D$      | 7,000   | 30            | 12-16            | 6,000                                  | 10            | 5-10             |
| $\emptyset 0.4$ | 0.1 - 0.2 $\emptyset D$      | 8,000   | 30            | 12-16            | 6,500                                  | 15            | 5-10             |
| $\emptyset 0.5$ | 0.1 - 0.2 $\emptyset D$      | 9,500   | 50            | 12-16            | 7,000                                  | 25            | 10-15            |
| $\emptyset 0.6$ | 0.1 - 0.2 $\emptyset D$      | 8,000   | 60            | 12-16            | 7,500                                  | 30            | 10-15            |
| $\emptyset 0.7$ | 0.1 - 0.2 $\emptyset D$      | 6,700   | 70            | 12-16            | 8,000                                  | 50            | 15-20            |
| $\emptyset 0.8$ | 0.1 - 0.2 $\emptyset D$      | 6,300   | 80            | 12-16            | 8,500                                  | 70            | 20-25            |
| $\emptyset 0.9$ | 0.1 - 0.2 $\emptyset D$      | 6,000   | 90            | 17-20            | 9,000                                  | 80            | 25-30            |
| $\emptyset 1$   | 0.1 - 0.2 $\emptyset D$      | 6,000   | 100           | 17-20            | 9,500                                  | 90            | 30-35            |
| $\emptyset 2$   | 0.1 - 0.2 $\emptyset D$      | 3,000   | 110           | 17-20            | 5,500                                  | 100           | 30-35            |
| $\emptyset 3$   | 0.1 - 0.2 $\emptyset D$      | 2,500   | 110           | 17-20            | 3,500                                  | 100           | 30-35            |

# 2 Flute

## Drilling Example 1

### ■ 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 drill also has the work material adhering to it.

#### ● Hole Position:

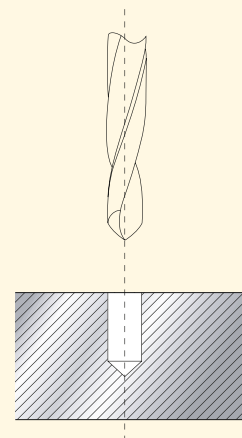
The solid carbide drill has minimal deflection when compared to a High Speed steel model, through the entire drilling cycle.

### ■ Drilling Condition

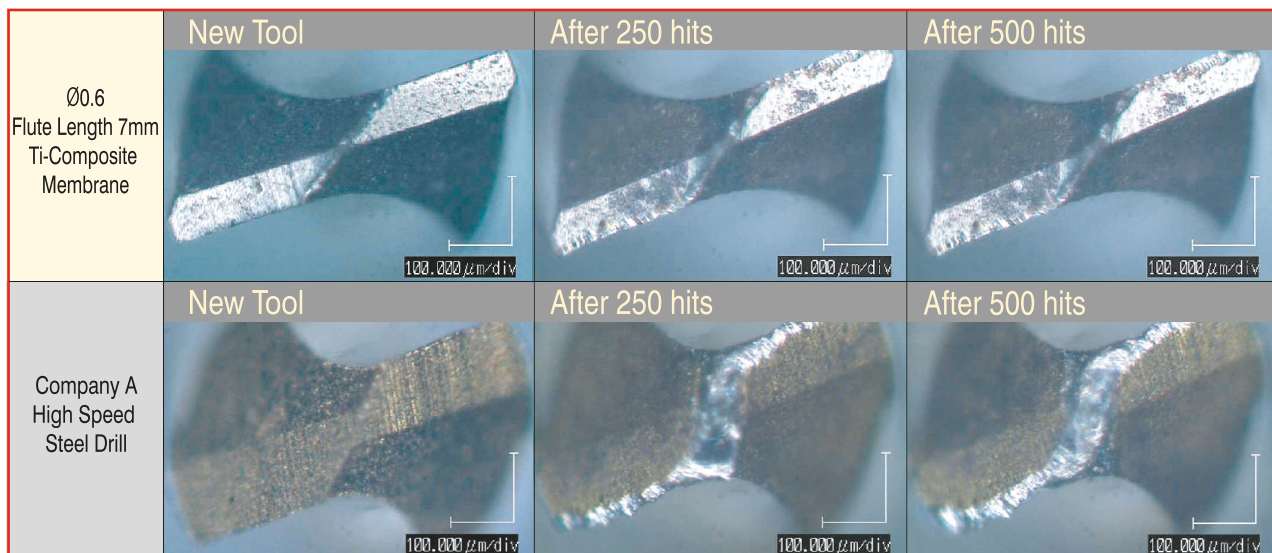
|                   |                                    |
|-------------------|------------------------------------|
| Tool:             | Ø0.6 × Flute Length 7mm            |
| Work Material:    | SUS304 (1.4301)                    |
| Spindle Speed:    | 8,000min <sup>-1</sup>             |
| Velocity:         | 15m/min                            |
| Z Feed Rate:      | 50mm/min                           |
| Chip Load:        | 0.00625mm/rev                      |
| Step Amount:      | 0.12 mm/time                       |
| Hole Depth:       | 2.4mm                              |
| Number of Holes:  | 500 Holes                          |
| Drilling Time :   | 25 min/100 holes                   |
| Overhang Length : | 10mm                               |
| Coolant:          | Water Soluble Cutting Oil (Nozzle) |

### Process Form

\*Blind Hole Step Process

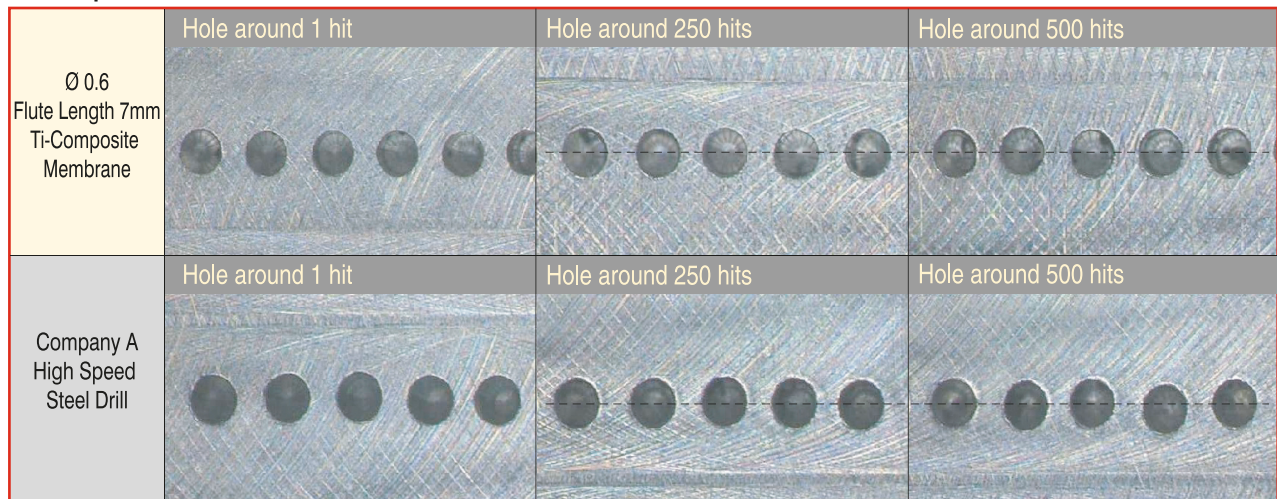


### ■ Comparison of Tip Damage



# 2 Flute

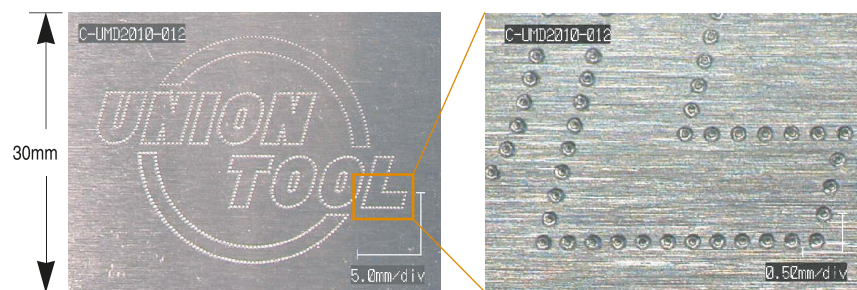
## Comparison of Hole Position



## Drilling Example 2

### Drilling Condition

Tool: Ø 0.1  
 Work Material: SUS304 (1.4301)  
 Number of Holes: 800 holes



|  | Spindle Speed (min <sup>-1</sup> ) | Feed Rate (mm/min) | Step Amount (mm/time) | Hole Depth (mm) | Drilling Time | Coolant       | Note               |
|--|------------------------------------|--------------------|-----------------------|-----------------|---------------|---------------|--------------------|
| Acrylic Ø 0.1                          |                                    |                    |                       |                 |               |               |                    |
| C-UMD Ø 0.1                            | 20,000                             | 20                 | 0.02                  | 1.00            | 1h30min       | Air Blow      | Direct+Drilling    |
| SUS304 (1.4301) Ø 0.1                  |                                    |                    |                       |                 |               |               |                    |
| Center Drill+chamfering<br>C-UMD Ø 0.2 | 10,000                             | 2                  | 0.01                  | 0.05            | 2h50min       | Water Soluble |                    |
| Drilling<br>C-UMD Ø 0.1                | 12,000                             | 4                  | 0.02                  | 0.20            | 3h27min       | Water Soluble |                    |
| Aluminum (A5052) Ø 0.2                 |                                    |                    |                       |                 |               |               |                    |
| C-UMD Ø 0.2                            | 16,000                             | 80                 | 0.04                  | 1.50            | 2h50min       | Water Soluble | Used back-up board |
| NAK55 (AISI P21) Ø 0.3                 |                                    |                    |                       |                 |               |               |                    |
| C-UMD Ø 0.3                            | 15,000                             | 15                 | 0.06                  | 1.50            | 3h35min       | Water Soluble | Used Center Drill  |
| SUS304 (1.4301) Ø 0.3                  |                                    |                    |                       |                 |               |               |                    |
| C-UMD Ø 0.3                            | 16,000                             | 30                 | 0.06                  | 1.50            | 2h24min       | Water Soluble | Used Center Drill  |



# 2 Flute

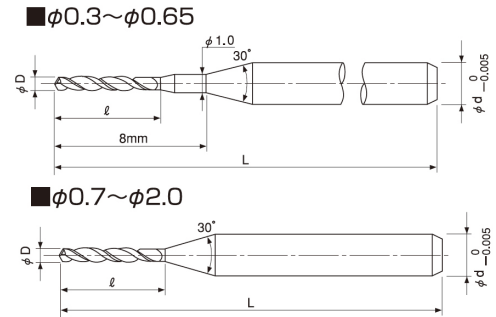
# UTDSX

Drill

Size  $\varnothing 0.3 - \varnothing 2$



| Number of Flutes | Process  |                |           | Work Material   |          |               |
|------------------|----------|----------------|-----------|-----------------|----------|---------------|
|                  | Roughing | Semi-Finishing | Finishing | Stainless Steel | Titanium | Chrome Cobalt |
| 2                |          |                |           | ●               | ●        |               |



Diameter Tolerance:  $\varnothing D 0/-0.01\text{mm}$   
Point Angle :  $130^\circ$

Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)

Unit (mm)

| Model Number   | Diameter $\varnothing D$ | Flute Length $\ell$ | Overall Length $L$ | Shank Diameter $\varnothing d$ |
|----------------|--------------------------|---------------------|--------------------|--------------------------------|
| UTDSX 2030-015 | 0.30                     | 1.5                 | 38                 | 3                              |
| UTDSX 2035-018 | 0.35                     | 1.8                 | 38                 | 3                              |
| UTDSX 2040-020 | 0.40                     | 2                   | 38                 | 3                              |
| UTDSX 2045-023 | 0.45                     | 2.3                 | 38                 | 3                              |
| UTDSX 2050-025 | 0.50                     | 2.5                 | 38                 | 3                              |
| UTDSX 2055-028 | 0.55                     | 2.8                 | 38                 | 3                              |
| UTDSX 2060-030 | 0.60                     | 3                   | 38                 | 3                              |
| UTDSX 2065-033 | 0.65                     | 3.3                 | 38                 | 3                              |
| UTDSX 2070-035 | 0.70                     | 3.5                 | 38                 | 3                              |
| UTDSX 2075-038 | 0.75                     | 3.8                 | 38                 | 3                              |
| UTDSX 2080-040 | 0.80                     | 4                   | 38                 | 3                              |
| UTDSX 2085-043 | 0.85                     | 4.3                 | 38                 | 3                              |
| UTDSX 2090-045 | 0.90                     | 4.5                 | 38                 | 3                              |
| UTDSX 2095-048 | 0.95                     | 4.8                 | 38                 | 3                              |
| UTDSX 2100-050 | 1.00                     | 5                   | 38                 | 3                              |
| UTDSX 2105-053 | 1.05                     | 5.3                 | 38                 | 3                              |
| UTDSX 2110-055 | 1.10                     | 5.5                 | 38                 | 3                              |
| UTDSX 2115-058 | 1.15                     | 5.8                 | 38                 | 3                              |
| UTDSX 2120-060 | 1.20                     | 6                   | 38                 | 3                              |
| UTDSX 2125-063 | 1.25                     | 6.3                 | 38                 | 3                              |
| UTDSX 2130-065 | 1.30                     | 6.5                 | 38                 | 3                              |
| UTDSX 2135-068 | 1.35                     | 6.8                 | 38                 | 3                              |
| UTDSX 2140-070 | 1.40                     | 7                   | 38                 | 3                              |
| UTDSX 2145-073 | 1.45                     | 7.3                 | 38                 | 3                              |
| UTDSX 2150-075 | 1.50                     | 7.5                 | 38                 | 3                              |
| UTDSX 2155-078 | 1.55                     | 7.8                 | 38                 | 3                              |
| UTDSX 2160-080 | 1.60                     | 8                   | 38                 | 3                              |
| UTDSX 2165-083 | 1.65                     | 8.3                 | 38                 | 3                              |
| UTDSX 2170-085 | 1.70                     | 8.5                 | 38                 | 3                              |
| UTDSX 2175-088 | 1.75                     | 8.8                 | 38                 | 3                              |
| UTDSX 2180-090 | 1.80                     | 9                   | 38                 | 3                              |
| UTDSX 2185-093 | 1.85                     | 9.3                 | 38                 | 3                              |
| UTDSX 2190-095 | 1.90                     | 9.5                 | 38                 | 3                              |
| UTDSX 2195-098 | 1.95                     | 9.8                 | 38                 | 3                              |
| UTDSX 2200-100 | 2.00                     | 10                  | 38                 | 3                              |

| Work Material     |                              | Stainless Steel (SUS304)<br>Use water soluble coolant. |               |                  | Titanium (Grade 5)<br>Use oil coolant. |               |                  |
|-------------------|------------------------------|--|---------------|------------------|--|---------------|------------------|
| Diameter (mm)     | Recommended Step Amount (mm) | Spindle Speed (min <sup>-1</sup> )                     | Feed (mm/min) | Velocity (m/min) | Spindle Speed (min <sup>-1</sup> )     | Feed (mm/min) | Velocity (m/min) |
| $\varnothing 0.3$ | 0.1 - 0.2 $\varnothing D$    | 7,000  | 30            | 12-16            | 6,000                                  | 10            | 5-10             |
| $\varnothing 0.4$ | 0.1 - 0.2 $\varnothing D$    | 8,000  | 30            | 12-16            | 6,500                                  | 15            | 5-10             |
| $\varnothing 0.5$ | 0.1 - 0.2 $\varnothing D$    | 9,500  | 50            | 12-16            | 7,000                                  | 25            | 10-15            |
| $\varnothing 0.6$ | 0.1 - 0.2 $\varnothing D$    | 8,000  | 60            | 12-16            | 7,500                                  | 30            | 10-15            |
| $\varnothing 0.7$ | 0.1 - 0.2 $\varnothing D$    | 6,700  | 70            | 12-16            | 8,000                                  | 50            | 15-20            |
| $\varnothing 0.8$ | 0.1 - 0.2 $\varnothing D$    | 6,300  | 80            | 12-16            | 8,500                                  | 70            | 20-25            |
| $\varnothing 0.9$ | 0.1 - 0.2 $\varnothing D$    | 6,000  | 90            | 17-20            | 9,000                                  | 80            | 25-30            |
| $\varnothing 1$   | 0.1 - 0.2 $\varnothing D$    | 6,000  | 100           | 17-20            | 9,500                                  | 90            | 30-35            |
| $\varnothing 2$   | 0.1 - 0.2 $\varnothing D$    | 3,000  | 130           | 17-20            | 5,500                                  | 100           | 30-35            |

# QR Code For Milling Conditions

## For Chrome Cobalt Material

### **CZS**

Square  
Size Ø1 - Ø20  
Unimax Series Vol. 16 Catalogue: Page 90  
Parameters 45 - 55 HRC



### **HLS 2000**

Long Neck Square  
Size Ø0.1 - Ø6  
Unimax Series Vol. 16 Catalogue: Page 115  
Parameters 45 - 55 HRC



### **HLS 4000**

Long Neck Square  
Size Ø1 - Ø6  
Unimax Series Vol. 16 Catalogue: Page 149  
Parameters 45 - 55 HRC



### **CNRS**

Corner Radius  
Size Ø6 - Ø12  
Unimax Series Vol. 16 Catalogue: Page 161  
Parameters Inconel 718



### **CRRS**

Long Neck Radius  
Size Ø6 - Ø12  
Unimax Series Vol. 16 Catalogue: Page 209  
Parameters 30 - 55 HRC



### **HRRS-S**

Long Neck Radius  
Size Ø2 - Ø12  
Unimax Series Vol. 16 Catalogue: Page 204  
Parameters 45 - 55 HRC



### **HLRS 4000**

Long Neck Radius  
Size Ø0.8 - Ø6  
Unimax Series Vol. 16 Catalogue: Page 200  
Parameters 45 - 55 HRC



# QR Code For Milling Conditions

## For Chrome Cobalt Material

### **CSEB**

*Ball*

*Size R0.05 - R6*

*Unimax Series Vol. 16 Catalogue: Page 234*

*Parameters 45 - 55 HRC*



### **CFB**

*Ball*

*Size R0.3 - R6*

*Unimax Series Vol. 16 Catalogue: Page 241*

*Parameters 45 - 55 HRC*



### **HFB**

*Ball*

*Size R1 - R6*

*Unimax Series Vol. 16 Catalogue: Page 246*

*Parameters 45 - 55 HRC*



### **CSELB**

*Long Neck Ball*

*Size R0.05 - R3*

*Unimax Series Vol. 16 Catalogue: Page 302*

*Parameters 45 - 55 HRC*



### **CFLB**

*Long Neck Ball*

*Size R0.3 - R3*

*Unimax Series Vol. 16 Catalogue: Page 322*

*Parameters Titanium*



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