UNION TOOL

Tungsten Carbide End Mills

UNIMAX Series Vol. 1

Dental applications

UNION TOOL EUROPE S.A.

Union Tool Presentation

Union Tool CO. is a global based leader in Dental technology that consistently delivers exceptional results. We work with respected Dental 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 are commited 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 Tools 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.

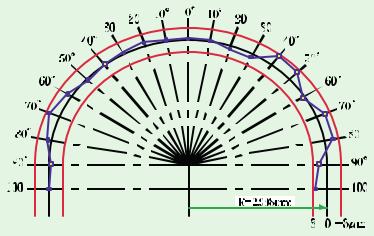
Values that inspire:

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

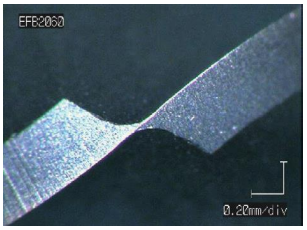
Precision that speaks for itself:

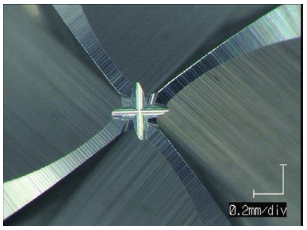
At Union Tool "precision" is in our DNA and is present in everything that we do. We offer standard tools with +/-3 micron radius tolerances. We also offer this precision and quality time and time again and batch after batch.

Measurements of Ball R Accuracy
Model : High R Tolerance Ball End Mill
Lot. No.:772001
No.001



Angle	L side	R side
0°	2.998	2.998
10°	2.998	2.998
20°	2.999	2.997
30°	2.998	2.997
40°	2.998	3.000
50°	2.997	3.000
60°	2.999	2.997
70°	3.000	3.000
80°	2.999	3.000
90°	2.997	2.997
100°	2.998	2.996
R Accuracy	R=2.998	+0.002 0.002
Actual Outer Diameter	φD=5.996	





Exceeding your expectations.

Icon Definitions

unit : mm

Tool Material

Super MG — Super Micro Grain

MG — Micro Grain

Shank Diameter Tolerance

Shank Dia 0/-0.005 — Tolerance of Shank Diameter : 0/-0.005

Coating

HARD MAX — HARDMAX

DIA COAT — DIAMOND COAT

UT COAT — UTCOAT

MICRO COAT — UT MICRO COAT

Ball Radius Tolerance

R ±0.005 — Ball Radius Tolerance : ±0.005

R ±0.007 — Ball Radius Tolerance : ±0.007

R ±0.01 — Ball Radius Tolerance : ±0.01

Helix Angle

45° — Helix Angle 45°

30° — Helix Angle 30°

24° — Helix Angle 24°

35° — Helix Angle 35°

Corner Radius Tolerance

R ±0.005 — Corner Radius Tolerance : ±0.005

R ±0.015 — Corner Radius Tolerance : ±0.015

R ±0.01 — Corner Radius Tolerance : ±0.01

Geometry

R — Corner Radius Design

Back Taper Geometry — Back Taper Geometry

Sharp Corner — Sharp Corner Design

Variable Pitch — Variable Pitch

Flatland — Flatland Design

X Thinning — X Thinning Design

Index

Alphabetical Order

Tool Type

Model Number	Appearance	Size	Number of Flutes	Process			Work Material		
				Roughing	Semi-Finishing	Finishing	Zirconium	Titanium	Chrome Cobalt
Long Neck Square									
HLS 2000		Ø0.1 - Ø6	2	■	■	■	●	●	●
DCLS		Ø0.4 - Ø6	2	■	■	■	●		
Long Neck Radius									
CRRS		Ø2 - Ø12	4	■	■	■		●	
HRRS-S		Ø2 - Ø12	4	■	■	■	●	●	●
HLRS 2000		Ø0.2 - Ø6	2	■	■	■	●	●	●
Long Neck Ball									
HSLB		R0.05 - R3	2	■	■	■	●	●	●
DCLB		R0.2 - R3	2	■	■	■	●		
CFLB		R0.3 - R3	3	■	■	■		●	
Drill									
C-UMD		Ø0.1 - Ø3	2				●	●	
UTDLX		Ø0.3 - Ø3	2				•	•	

2 Flute

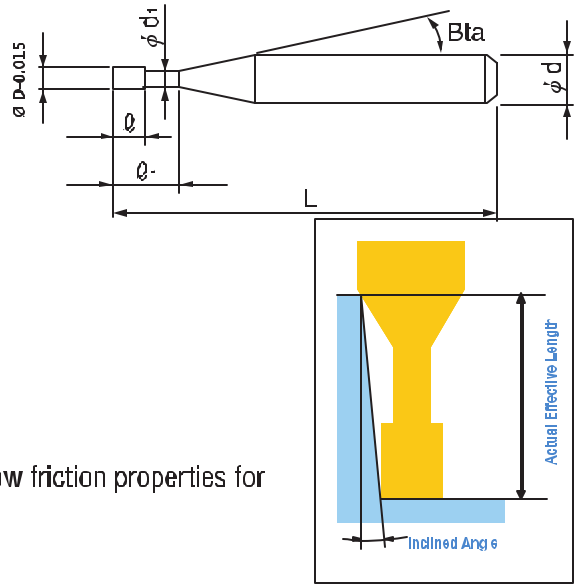
HLS 2000

Long Neck Square
Size Ø0.1 - Ø6

Super MG | HARD MAX | 30° | Flat Land | Shank Dia 0/-0.005

Number of Flutes	Process			Work Material		
	Roughing	Semi-Finishing	Finishing	Zirconium	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 D	Effective Length ℓ1	Length of Cut ℓ	Neck Diameter Dc1	Shank Taper Angle Bta	Overall Length L	Shank Diameter Dd	Effective Length by Inclined angles 30'	1°	1°30'	2°	3°
HLS 2005-D0	0.5	10	0.7	0.48	16°	50	4	10.89	11.19	11.45	11.72	12.12
HLS 2005-15		15				50	4	15.00	16.44	16.76	17.05	17.50
HLS 2010-D0	1	10	1.5	0.95	16°	45	4	10.99	11.36	11.76	12.19	13.10
HLS 2010-15		15				50	4	17.99	17.78	18.36	19.02	20.44
HLS 2010-200		20				55	4	21.85	22.04	22.76	23.57	25.34
HLS 2020-D0	2	10	3	1.9	16°	45	4	10.85	10.99	11.36	11.44	12.29
HLS 2020-15		15				50	4	15.54	17.08	17.65	18.27	no tolerance
HLS 2020-200		20				55	4	20.67	21.34	22.05	22.82	no tolerance
HLS 2030-D0	3	10	4.5	2.92	16°	45	6	10.85	10.99	11.36	11.43	12.29
HLS 2030-15		15				60	6	15.54	17.08	17.65	18.25	19.63
HLS 2030-200		20				60	6	20.66	21.34	22.05	22.82	24.53

For Chrome Cobalt Milling Condition please refer to page 115 : Hardened Steels 45-55 HRC in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 21)

Work Material				Zirconium Use air coolant			Titanium (Grade 5) Use water soluble coolant			Radial Depth
Model Number	Outside Diameter	Effective Length	L/D	Speed (min⁻¹)	Feed Rate (mm/min)	Axial Depth a_p (mm)	Speed (min⁻¹)	Feed Rate (mm/min)	Axial Depth a_p (mm)	Radial Depth a_e (mm)
HLS 2005	0.5	10	20	34,000	200	0.002 - 0.003	32,300	190	0.001 - 0.002	0.005
		15	30	34,000	150	0.001 - 0.002	24,100	90	0.001	0.003
HLS 2010	1	10	10	22,100	530	0.005 - 0.008	16,200	190	0.003 - 0.004	0.013
		15	15	14,300	300	0.002 - 0.003	12,100	230	0.003 - 0.006	0.008
		20	20	13,500	200	0.001 - 0.002	10,600	130	0.003 - 0.004	0.002
HLS 2020	2	10	5	27,000	1680	0.013 - 0.022	12,600	730	0.040 - 0.057	0.200
		15	8	19,500	1230	0.007 - 0.013	9,700	470	0.024 - 0.039	0.019
		20	10	16,500	750	0.004 - 0.007	8,100	390	0.016 - 0.027	0.025
HLS 2030	3	10	3.5	23,000	2300	0.027 - 0.045	9,500	930	0.052 - 0.138	1.013
		15	5	22,000	2200	0.019 - 0.034	7,700	670	0.038 - 0.096	0.217
		20	6.5	17,000	1700	0.015 - 0.025	6,300	530	0.048 - 0.079	0.127

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

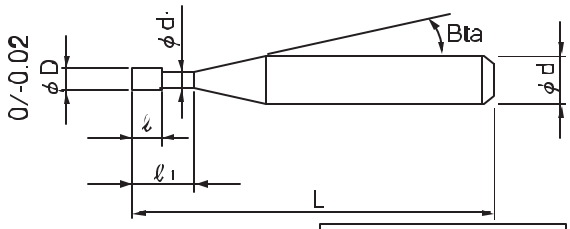
2 Flute

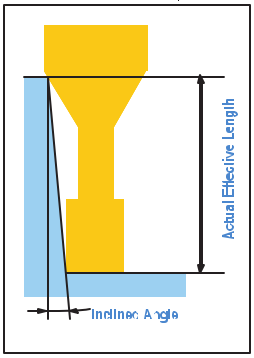
DCLS

Long Neck Square
Size Ø0.4 - Ø6

MG | DIA COAT | 30° | Shank Dia 0/-0.005

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





Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)

DIAMOND Coating 2 flute, square design with long neck for milling Zirconium materials. New diamond coating, with a highly adhesive base layer, offers excellent wear resistance and up to 20x longer tool life.

Unit (mm)

Model Number	Outside Diameter ØD	Effective Length ℓ2	Length of Cut ℓ	Neck Diameter Ød1	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Effective Length by Inclined angles 30°	1°	1°30'	2°	3°
DCLS 2006-100	0.6	10	1.2	0.57	1°6'	45	4	10.90	11.38	11.71	12.12	13.03
DCLS 2010-100	1	10	2	0.95	1°6'	45	4	10.91	11.34	11.72	12.13	13.01
DCLS 2010-160		16				60	4	17.10	17.73	18.32	18.95	20.38
DCLS 2010-210		21				65	4	22.33	23.06	23.82	24.65	26.60
DCLS 2015-100	1.5	10	3	1.41	1°6'	45	4	10.29	10.53	10.96	11.37	12.99
DCLS 2015-160		16				60	4	17.48	17.02	17.59	18.20	19.66
DCLS 2015-210		21				65	4	21.64	22.34	23.09	23.89	[illegible]
DCLS 2020-100	2	10	4	1.9	1°6'	60	4	10.26	10.58	11.04	11.45	12.98
DCLS 2020-160		16				60	4	16.53	17.07	17.65	18.25	[illegible]
DCLS 2020-210		21				65	4	21.68	22.40	23.16	23.95	[illegible]
DCLS 2030-160	3	16	6	2.9	1°6'	70	6	16.53	17.07	17.65	18.25	19.63
DCLS 2030-320		32				80	6	33.04	34.11	35.29	36.45	[illegible]

Work Material				Zirconium Use Air blow coolant.			Titanium (Grade 5)			Radial Depth
Model Number	Outside Diameter	Effective Length	L/D	Speed (min⁻¹)	Feed Rate (mm/min)	Axial Depth a_p (mm)	Speed (min⁻¹)	Feed Rate (mm/min)	Axial Depth a_p (mm)	Radial Depth a_e (mm)
DCLS 2003	0.6	10	16	24,000	120	0.6	N/A	N/A	N/A	0.025
DCLS 2010	1	10	10	21,100	580	1	N/A	N/A	N/A	0.05
		16	16	14,500	300	1	N/A	N/A	N/A	0.05
		21	21	12,500	200	1	N/A	N/A	N/A	0.05
DCLS 2015	1.5	10	6	17,000	1,050	1.5	N/A	N/A	N/A	0.075
		16	10	15,000	500	1.5	N/A	N/A	N/A	0.075
		21	14	10,000	370	1.5	N/A	N/A	N/A	0.075
DCLS 2020	2	10	5	21,000	1,680	2	N/A	N/A	N/A	0.1
		16	8	19,500	1,230	2	N/A	N/A	N/A	0.1
		21	10	16,000	760	2	N/A	N/A	N/A	0.1
DCLS 2030	3	16	5	12,000	2,200	3	N/A	N/A	N/A	0.15
		32	10	15,000	1,040	3	N/A	N/A	N/A	0.15

* 33 models available in total from Diameter 0.4mm to 6mm with various length of cut from 3 to 20 times diameter
For more details please ask your distributor.
* N/A : Non Applicable

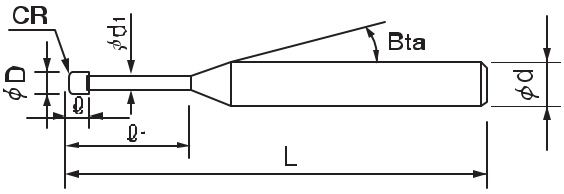
4 Flute

HRRS-S

Long Neck Radius
Size Ø2 - Ø12

Super MG | HARD MAX | 45° | R | R ±0.01 (2 – 06) | R −0.015 (2 – 012) | Shank Dia 0/-0.005 | Back Taper Coolant Ty | Variable Pitch

Number of Flutes	Process			Work Material		
	Roughing	Semi-Finishing	Finishing	Zirconium	Titanium	Chrome Cobalt
4	■	■	□	●	●	●



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

- Shorter overall length and overhang offers higher feed and precision.
- Special corner radius geometry / size offers larger step over.
- Seamless corner radius.
- Longer tool life with HARDMAX coating.

Unit (mm)

Model Number	Outside Diameter φD	Corner Radius CR	Effective Length ℓ1	Length of Cut ℓ	Neck Diameter φd	Shank Taper Angle Bta	Overall Length L	Shank Diameter φd
HRRS 4020-03-06S	2	R0.3	6	2	1.9	15°	45	4
HRRS 4020-05-06S	2	R0.5	6	2	1.9	15°	45	4
HRRS 4030-08-09-3S	3	R0.8	9	3	2.92	-	50	3
HRRS 4040-05-12S	4	R0.5	12	4	3.82	-	50	4
HRRS 4040-10-12S	4	R1	12	4	3.82	-	50	4

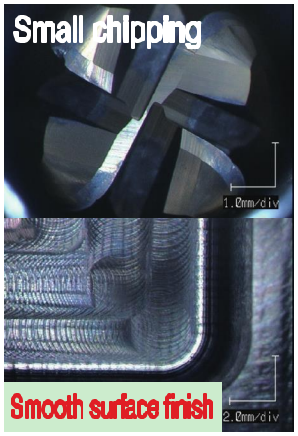
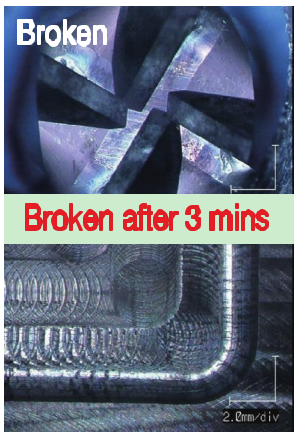
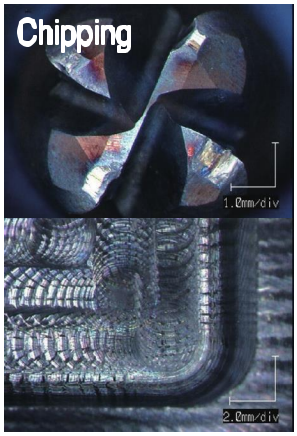
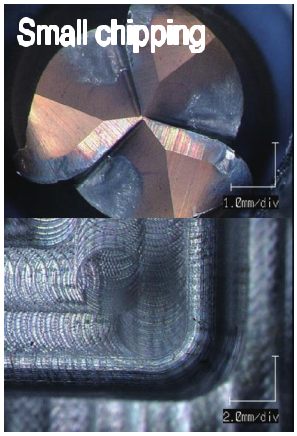
For Chrome Cobalt Milling Condition please refer to page 204; Hardened Steels 45-55 HRC in our UN MAX Series Vol. 16 Catalogue (QR CODE page 21)

Work Material			Zirconium (Use Air Blow coolant)				Titanium (Grade 5) (Use milling Jet mist coolant)			
Model Number	Outside Diameter (mm)	Length of Cut	Spindle Speed (min⁻¹)	Feed (mm/min)	ap Axial Depth (mm)	ae Radial Depth (mm)	Spindle Speed (min⁻¹)	Feed (mm/min)	ap Axial Depth (mm)	ae Radial Depth (mm)
HRRS 4020-03-06S	2	2	30,000	7,200	0.04	0.66	8,000	700	1.0	0.35
HRRS 4020-05-06S	2	2	30,000	7,200	0.04	0.66	8,000	700	2.0	0.1
HRRS 4030-08-09-3S	3	3	20,000	7,200	0.04	1.08	6,000	750	2.0	0.1
HRRS 4040-05-12S	4	4	15,000	7,200	0.05	1.32	4,000	750	3.0	0.2
HRRS 4040-10-12S	4	4	15,000	7,200	0.05	1.53	4,000	750	3.0	0.9

*28 models available in data from Diameter 2mm to 12mm with various Corner Radius from 0.3mm to 4mm.
For more details please ask your distributor.

4 Flute

Milling Example: NAK80 (40HRC) Pocket Milling Comparison using HRRS Ø 6 x CR1.5

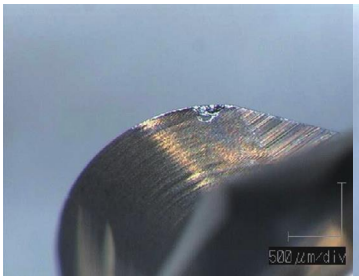
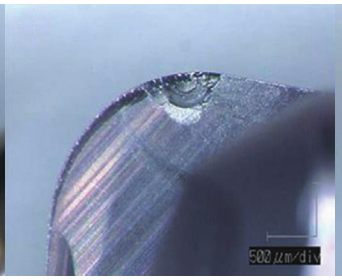
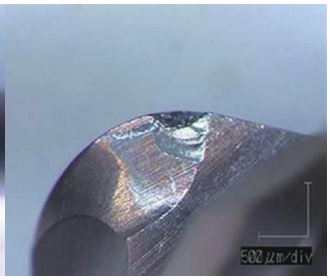
HRRS	Competitor A: 4 Flutes	Competitor B: 4 Flutes	Competitor C: 3 Flutes
			
CR1.5, FL 6mm, EFL 18mm	CR1.5, FL 6mm, EFL 18mm	CR1.5, FL 12mm	CR1.5, FL 12mm

Excellent resistance to chipping and surface quality!

Spindle Speed: 9,000min-1
Feed Rate: 11,000mm/min
Axial Depth: 0.3mm(0.05D)
Radial Depth: 3mm(0.5D)
Overhang: 20mm
Pocket Size: 40mmx180mmx15mm depth
Cycle Time: 20 minutes

Original Corner Radius Design Offers High Rigidity and Reduces Cutting Force

After milling SKD11 (60HRC)

HRRS	Competitor	Competitor
		
Seamless corner radius with equal taper angle design. Reduce the cutting force and offers excellent chip evacuation to protect from the tool damage.	Flat and non helix cash design. Badly damaged at lip point where cutting chips are trapped by poor chip evacuation.	Flat and helical cash design. Huge tool damage at tangent point where the cash shape abruptly changed and cutting chips could not evacuate properly.

Spindle Speed	: 2,700min^{-1}	Axial Depth	: 0.3mm	Overhang	: 20mm
Feed Rate	: 2,000mm/min	Radial Depth	: 1.5mm	Pocket Size	: 40mm×40mm×0.3mm

Longer Tool Life with Variable Pitch Design. Recommended for Various Coolant Types.

4 Flute

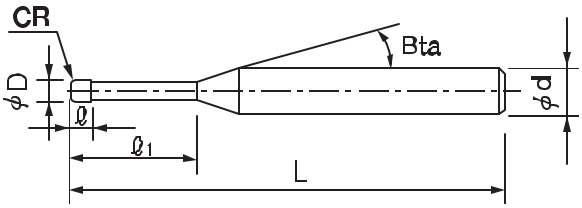
CRRS

Long Neck Radius
Size Ø2 - Ø12

Super MG | UT COAT | 45° | R | R ±0.01 (Ø2 - Ø6) | R ±0.015 (Ø8 - Ø12) | Shank Dia 0/-0.005 | Back Taper Geometry | Variable Pitch

Number of Flutes	Process			Work Material		
	Roughing	Semi-Finishing	Finishing	Zirconium	Titanium	Chrome Cobalt
4	■	■	□		●	

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



- UTCOAT Coating offers longer tool life milling Titanium.
- Variable pitch, high helix and positive rake angle offers stable milling.
- Reduced cutting force when using a helical approach or inclined angles.

Unit (mm)

Model Number	Outside Diameter ØD	Corner Radius CR	Effective Length ℓ1	Length of Cut ℓ	Neck Diameter Ød1	Shank Taper Angle Bta	Overall Length L	Shank Diameter 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

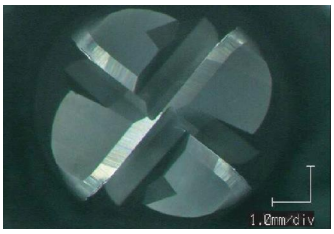
Work Material			Zirconium				Titanium (Grade 5) Use oil coolant.			
Model Number	Outside Diameter (mm)	Length of Cut (mm)	Spindle Speed (min⁻¹)	Feed (mm/min)	ap Axial Depth (mm)	ae Radial Depth (mm)	Spindle Speed (min⁻¹)	Feed (mm/min)	ap Axial Depth (mm)	ae Radial Depth (mm)
CRRS 4020-05-06	2	2	N/A	N/A	N/A	N/A	7,960	700	0.04	0.66
CRRS 4030-08-09	3	3	N/A	N/A	N/A	N/A	5,300	700	0.04	1.08
CRRS 4040-05-12	4	4	N/A	N/A	N/A	N/A	4,780	750	0.05	1.32
CRRS 4040-10-12	4	4	N/A	N/A	N/A	N/A	4,780	750	0.05	1.32

*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.
*N/A : Non Applicable

4 Flute

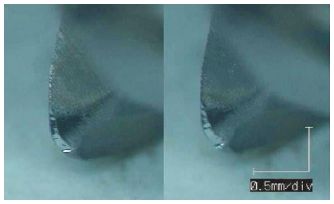
Milling Example: Pocket Milling by Different Work Materials Tool: CRRS(Ø 6×CR0.5)

Work Material	S50C
Spindle Speed	10,000min^{-1}
Feed Rate	12,000mm/min
Axial Depth a_p	0.1mm
Radial Depth a_e	2.4mm
Overhang	24mm
Work Material Size	95mm×90mm×15mm (X×Y×Z)
Cycle Time	90 minutes
Coolant	Air Blow (Nozzle)

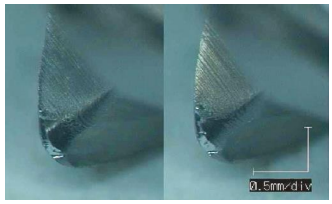


Flank wear:
0.070 mm

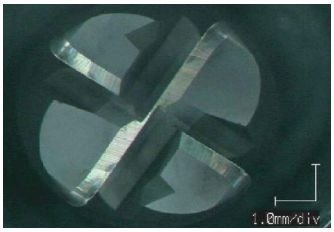
Sub Flute



Main Flute

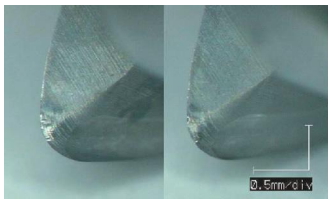


Work Material	SUS304
Spindle Speed	10,000min^{-1}
Feed Rate	7,200mm/min
Axial Depth a_p	0.0/mm
Radial Depth a_e	1.92mm
Overhang	24mm
Work Material Size	90mm×44mm×18mm (X×Y×Z)
Cycle Time	84 minutes
Coolant	Water Soluble

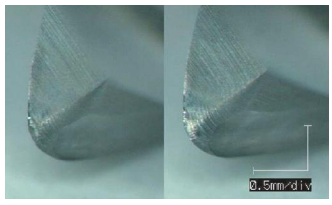


Flank wear:
0.032 mm

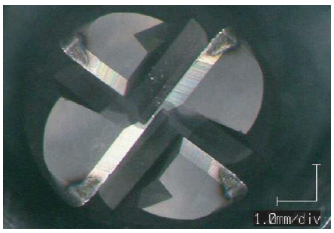
Sub Flute



Main Flute

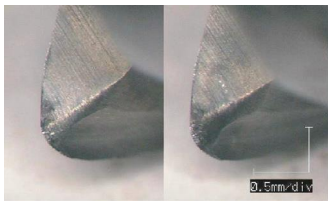


Work Material	STAVAX (52HRC)
Spindle Speed	8,000min^{-1}
Feed Rate	5,250mm/min
Axial Depth a_p	0.0/mm
Radial Depth a_e	1.75mm
Overhang	24mm
Work Material Size	95mm×25mm×12mm (X×Y×Z)
Cycle Time	56 minutes
Coolant	Oil Mist

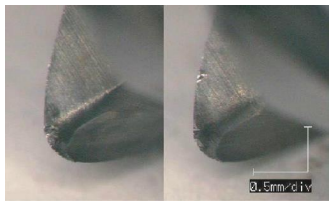


Flank wear:
0.087 mm

Sub Flute



Main Flute



2 Flute

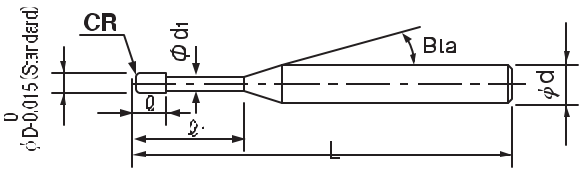
HLRS 2000

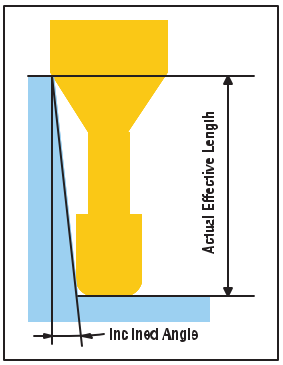
Long Neck Radius
Size Ø0.2 - Ø6

Number of Flutes	Process			Work Material		
	Roughing	Semi-Finishing	Finishing	Zirconium	Titanium	Chrome cobalt
2	■	■	□	●	●	●

Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, □ suitable)





- The 4 flute design offers high milling efficency 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 Ø D	Corner Radius CR	Effective Length ℓ1	Length of cut ℓ	Neck Diameter Ø d1	Shank Taper Angle B.a	Overall Length L	Shank Diameter Ø d
-LRS 2008-0C5-050	0.8	R0.05	5	0.8	0.73	15°	50	4
-LRS 2008-0C5-080			8					
-LRS 2010-0C5-100	1.0	R0.05	10	1	0.96	15°	50	4
-LRS 2010-0C5-150			15				60	
-LRS 2010-0C5-200			20				60	
-LRS 2010-01-100		R0.1	10				50	
LRS 2010-01-150			15				60	
-LRS 2010-01-200			20				60	
-LRS 2012-02-120	1.2	R0.2	12	1.2	1.14	15°	55	4
LRS 2012-02-200			20				60	
HLRS 2015-005-100	1.5	R0.05	10	1.5	1.45	15°	50	4
HLRS 2015-01-100		R0.1	10					
HLRS 2015-01-150			15				55	
HLRS 2015-01-200			20				60	
HLRS 2020-005-100	2.0	R0.05	10	2	1.92	15°	50	4
HLRS 2020-01-100		R0.1	10				55	
HLRS 2020-01-150			15				60	
HLRS 2020-01-200			20					
HLRS 2025-01-100	2.5	R0.1	10	2.5	2.42	15°	50	4
HLRS 2025-01-200			20				60	
HLRS 2030-01-120	3	R0.1	12	3	2.92	15°	55	6
HLRS 2030-01-150			15				60	
HLRS 2030-01-200			20				60	
HLRS 2030-02-120		R0.2	12				55	
HLRS 2030-02-150			15				60	
HLRS 2030-02-200			20				60	

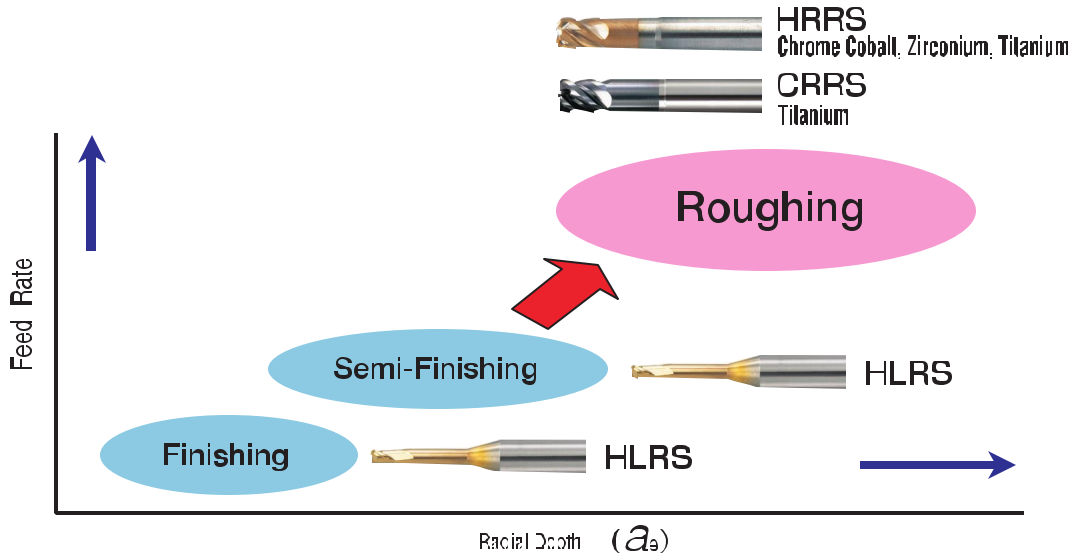
* 351 models available in total from Diameter Ø 2mm to 8mm with various corner radius from 0.05mm to 1mm.
For more details please ask your distributor.

2 Flute

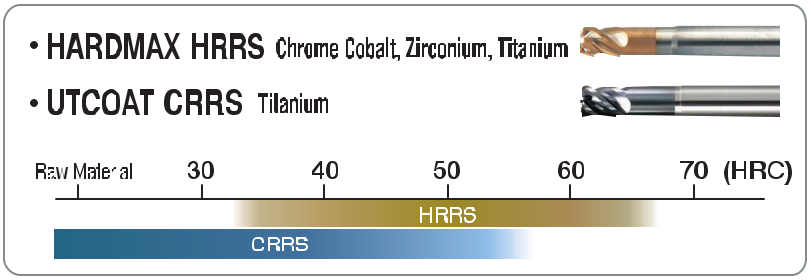
For Chrome Cobalt Milling Condition please refer to page 184 : Hardened Steels 45-55 HRC in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 21)

Work Material				Zirconium (use Air blow coolant)			Titanium (Grade 5) (use Oil coolant)			Radial Depth
Model Number	Outside Diameter	Effective Length	L/D	Spindle Speed (min^{-1})	Feed Rate (mm/rev)	Axial Depth a_p (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/rev)	Axial Depth a_p (mm)	Radial Depth a_e (mm)
HLRS 2008	0.8	6	7.5	8,500	30	0.004	23,000	250	0.02	0.128
		8	10	7,600	20	0.002	22,000	200	0.013	0.080
HLRS 2010	1	10	10	5,400	32	0.006	19,500	250	0.030	0.126
		16	16	4,300	19	0.002	16,000	200	0.025	0.097
		20	20	3,900	13	0.001	15,000	180	0.020	0.018
HLRS 2012	1.2	12	10	4,500	659	0.004	15,000	300	0.030	0.072
		20	16.6	3,900	22	0.002	13,000	200	0.020	0.018
HLRS 2015	1.5	10	6.6	6,000	95	0.022	15,000	300	0.010	0.298
		16	10.6	4,700	58	0.011	12,300	250	0.035	0.190
		20	13.3	4,200	46	0.003	11,600	200	0.030	0.138
HLRS 2020	2	10	5	7,600	113	0.028	10,000	350	0.060	0.595
		16	8	5,900	80	0.022	8,000	300	0.050	0.315
		20	10	5,300	84	0.014	8,000	250	0.040	0.138
HLRS 2025	2.5	10	4	8,400	154	0.018	7,500	350	0.070	0.540
		20	8	6,300	81	0.022	7,000	250	0.060	0.225
HLRS 2030	3	12	4	9,000	200	0.075	6,500	400	0.070	0.670
		16	5.5	7,900	173	0.051	6,000	350	0.060	0.630
		20	6.6	7,100	150	0.044	5,000	300	0.050	0.620

Usage of Radius Series



4 Flute Active Corner Radius End Mill's Target Hardness



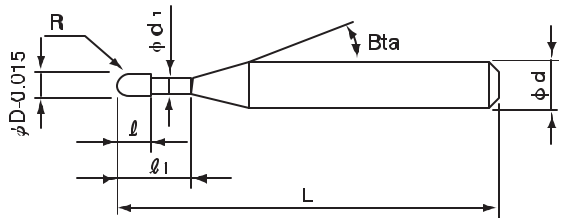
2 Flute

HSLB

Long Neck Ball
Size R0.05 - R3

Super MG | HARD MAX | Shank Dia 0/-0.005 | Special Taper Geometry

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



Applicable Work Material (● most suitable, ●suitable)

Applicable Process (■ most suitable, ■ suitable)

The latest version of HARDMAX Coating keeps the same hardness but improves resistance to oxidation at high temperatures. Suitable for both dry and wet coolant. Ball tip radius is designed with a negative rake angle that minimizes wear and improves the target dimensions. Amazing efficiency with long life.

Unit (mm)

Model Number	Radius of Ball Nose R	Effective Length of cut ℓ1	Length of cut ℓ	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ø d
HSLB 2010-100	R0.5	10	0.8	16°	45	4
HSLB 2010-160	R0.5	16	0.8	16°	50	4
HSLB 2010-200	R0.5	20	0.8	16°	55	4
HSLB 2020-100	R1	10	1.6	16°	45	4
HSLB 2020-160	R1	16	1.6	16°	50	4
HSLB 2020-200	R1	20	1.6	16°	55	4
HSLB 2040-100	R2	10	3.2	16°	70	6
HSLB 2040-160	R2	16	3.2	16°	70	6
HSLB 2040-200	R2	20	3.2	16°	70	6
HSLB 2060-100	R3	10	4.8	16°	80	8
HSLB 2060-150	R3	15	4.8	16°	80	8
HSLB 2060-200	R3	20	4.8	16°	80	8

For Chrome Cobalt Milling Conditions please refer to page 269 : Hardened Steels 55-62 HRC in our UN MAX Series Vol. 16 Catalogue (QR CODE page 21).

Work Material			Zirconium Use air blow coolant.				Titanium (Grace 5) Use Oil coolant.			
Mode Number	Radius of Ball Nose (mm)	Length of Cut	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	ap Axial Depth (mm)	ae Radial Depth (mm)	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	ap Axial Depth (mm)	ae Radial Depth (mm)
HSLB 2010-100	R0.5	10	33,500	1,500	0.15	0.10	20,000	250	0.015	0.016
HSLB 2010-160	R0.5	16	33,500	1,500	0.12	0.10	14,000	220	0.007	0.015
HSLB 2010-200	R0.5	20	33,500	1,500	0.10	0.10	13,000	200	0.005	0.015
HSLB 2020-100	R1	10	27,000	1,500	0.45	0.20	30,000	400	0.012	0.024
HSLB 2020-160	R1	16	27,000	1,500	0.38	0.20	15,000	350	0.008	0.024
HSLB 2020-200	R1	20	27,000	1,500	0.24	0.20	12,000	300	0.007	0.021
HSLB 2040-100	R2	10	13,500	1,750	0.90	0.60	24,000	1,000	0.020	0.010
HSLB 2040-160	R2	16	13,500	1,750	0.70	0.60	18,000	700	0.016	0.033
HSLB 2040-200	R2	20	13,500	1,750	0.65	0.60	15,000	500	0.011	0.033
HSLB 2060-100	R3	10	9,000	1,400	1.8	0.90	16,000	900	0.025	0.050
HSLB 2060-150	R3	15	9,000	1,400	1.2	0.90	16,000	700	0.230	0.046
HSLB 2060-200	R3	20	9,000	1,400	0.9	0.90	16,000	600	0.015	0.045

* 282 models available in total from Radius R0.05 mm to R3 mm with effective length from 4 to 40 times diameter.
For more details please ask your distributor.

Study Case Chrome - Cobalt

The HARDMAX Coating offers an amazing tool life on hard materials such as Chrome - Cobalt Alloys.
With one set of HARDMAX Coating Tools you can achieve more than 50 implants.

HLS	2 flute Square End mill
HLRS	2 flute Corner Radius End mill
HRRS	4 flute Corner Radius End mill
HSLB	2 flute Ball nose End mill

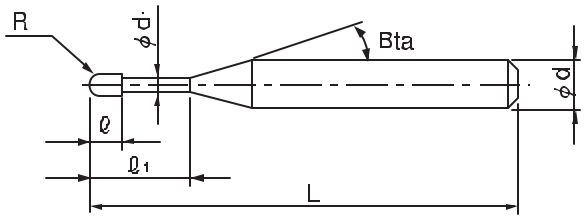
2 Flute

DCLB

Long Neck Ball
Size R0.2 - R3

MG | DIA COAT | 35° | R ±0.01 | Shank Dia 0/-0.005

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



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

DIAMOND Coating 2 flute, ball design with long neck for milling Zirconium materials. New diamond coating, with a highly adhesive base layer, offers excellent wear resistance for high efficiency milling and up to 20x longer tool life over uncoated tools.

Unit (mm)

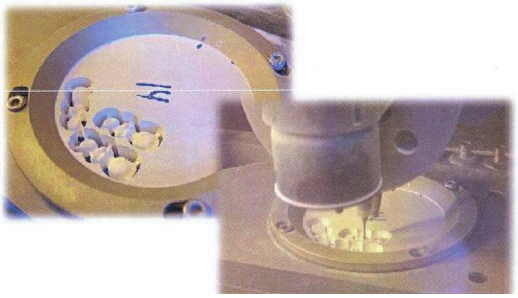
Model Number	Radius of Ball Nose R	Effective Length of cut ℓ1	Length of cut ℓ	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ø d
DCLB 2010-0100	R0.5	10	1.5	16°	45	4
DCLB 2010-0160	R0.5	16	0.8	16°	50	4
DCLB 2010-0200	R0.5	20	0.8	16°	60	4
DCLB 2020-0100	R1	10	1.6	16	45	4
DCLB 2020-0160	R1	16	1.6	16°	50	4
DCLB 2020-0200	R1	3	3	16°	70	4
DCLB 2040-0160	R2	16	3.2	16°	70	4
DCLB 2040-0200	R2	20	3.2	16°	70	4
DCLB 2060-0300	R3	30	4.8	16°	80	4

Work Material			Zirconium (Use Air blow coolant.)				Titanium (Grade 5) (Use Oil coolant.)			
Model Number	Radius of Ball Nose (mm)	Length of Cut	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	Axial Depth ap (mm)	Radial Depth ae (mm)	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	Axial Depth ap (mm)	Radial Depth ae (mm)
DCLB 2010-0100	R0.5	10	33,500	1,500	0.13	0.10	N/A	N/A	N/A	N/A
DCLB 2010-0160	R0.5	16	33,500	1,500	0.12	0.10	N/A	N/A	N/A	N/A
DCLB 2010-0200	R0.5	20	33,500	1,500	0.13	0.10	N/A	N/A	N/A	N/A
DCLB 2020-0100	R1	10	27,000	1,500	0.48	0.20	N/A	N/A	N/A	N/A
DCLB 2020-0160	R1	16	27,000	1,500	0.39	0.20	N/A	N/A	N/A	N/A
DCLB 2020-0200	R1	20	27,000	1,500	0.24	0.20	N/A	N/A	N/A	N/A
DCLB 2040-0160	R2	16	13,500	1,750	0.70	0.60	N/A	N/A	N/A	N/A
DCLB 2040-0200	R2	20	13,500	1,750	0.65	0.60	N/A	N/A	N/A	N/A
DCLB 2060-0300	R3	30	9,000	1,400	0.90	0.90	N/A	N/A	N/A	N/A

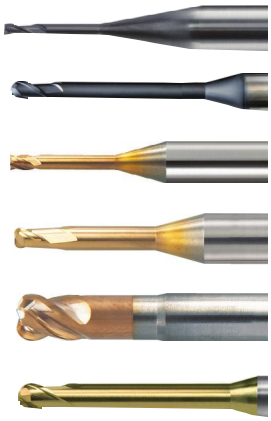
* 67 models available in total from Radius R0.2 mm to R3 mm with effective length from 1 to 10 times diameter.
For more details please ask your distributor.

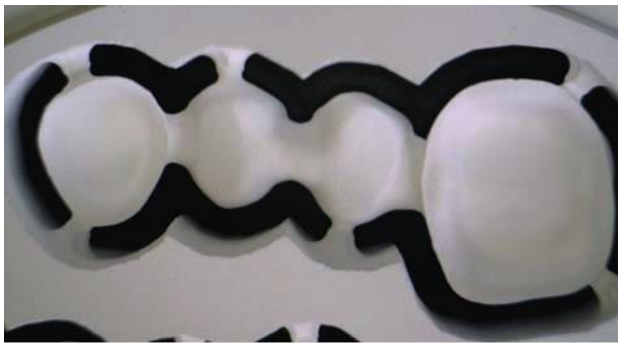
Study Case Zirconium

The DIAMOND and HARDMAX Coatings offer an amazing tool life on hard materials such as Zirconium.



DCLS	2 flute Square end mill
DCLB	2 flute Square end mill
HLS	2 flute Square end mill
HLRS	2 flute Corner Radius end mill
HRRS	4 flute Corner Radius end mill
HSLB	2 flute Ball nose end mill





3 Flute

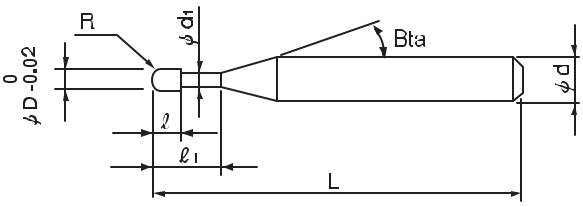
CFLB

Long Neck Ball
Size R0.3 - R3

Super MG | UT COAT | 30° | R ±0.005 R0.3 - R1.5 | R ±0.007 R2 - R3 | Shank Dia 0/-0.005 | Variable Pitch

Number of Flutes	Process			Work Material		
	Roughing	Semi-Finishing	Finishing	Zirconium	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 R 0.75mm and larger.
Diameter tolerance : 0 / -0.02mm.

Unit (mm)

Model Number	Radius of Ball Nose R	Effective Length ℓ1	Length of Cut ℓ	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ø d
CFLB 3015-100	R0.75	10	1.2	16°	50	4
CFLB 3020-100	R1	10	1.6	16°	50	4
CFLB 3020-160	R1	16	1.6	16°	50	4
CFLB 3030-100	R1.5	10	2.4	16°	60	6
CFLB 3030-160	R1.5	16	2.4	16°	60	6
CFLB 3030-200	R1.5	20	2.4	16°	70	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

Work Material			Zirconium (Use Air blow cooling)				Titanium (Grade 5) (Use oil coolant)			
Model Number	Radius of Ball Nose (mm)	Effective Length (mm)	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	Axial Depth (mm)	Radial Depth (mm)	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	Axial Depth (mm)	Radial Depth (mm)
CF_3 3015-100	R0.75	10	NA	NA	NA	NA	16,000	2,000	0.025	0.19
CF_3 3020-100	R1	10	NA	NA	NA	NA	8,000	3,000	0.100	0.43
CF_3 3020-160	R1	16	NA	NA	NA	NA	8,400	1,200	0.050	0.34
CF_3 3030-100	R1.5	10	NA	NA	NA	NA	6,000	4,000	0.150	0.56
CF_3 3030-160	R1.5	16	NA	NA	NA	NA	11,200	2,800	0.138	0.52
CF_3 3030-200	R1.5	20	NA	NA	NA	NA	8,000	2,000	0.120	0.56
CF_3 3040-120	R2	12	NA	NA	NA	NA	12,000	4,000	0.200	0.87
CF_3 3040-160	R2	16	NA	NA	NA	NA	10,800	3,600	0.200	0.87
CF_3 3040-200	R2	20	NA	NA	NA	NA	9,000	3,000	0.200	0.87

* 32 models available in total from Radius R0.3 mm to R3 mm. Mill length of cut from 5 to 15 times diameter.
For more details please ask your distributor.

Study Case Titanium

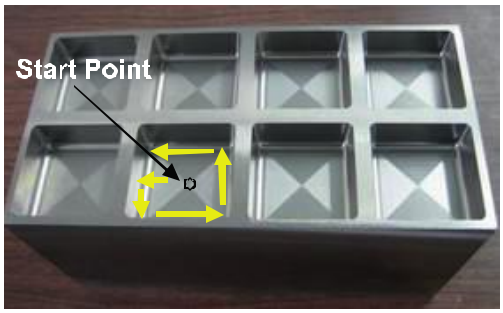
The UTCOAT Coating offers an amazing tool life on hard material such as Titanium.

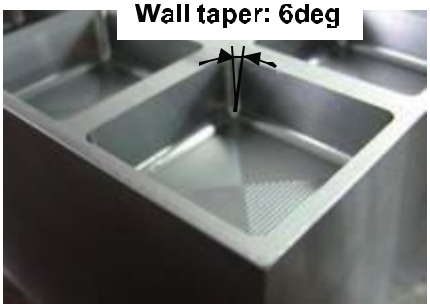
CRRS	2 flute Corner Radius end mill
CFB	2 flute Ball Nose end mill
HLS	2 flute Square End mill
HLRS	2 flute Corner Radius End mill
HSLB	2 flute Ball Nose End mill

Study Case Titanium

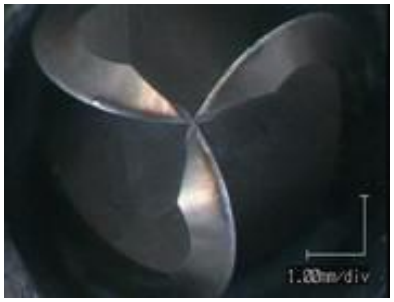
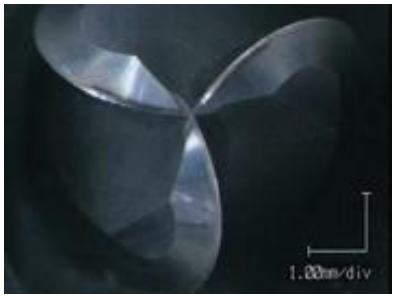
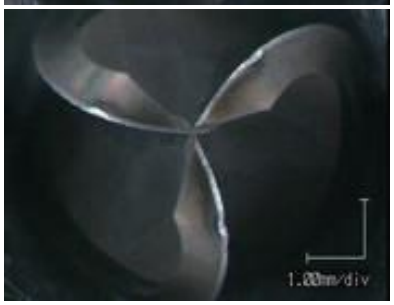
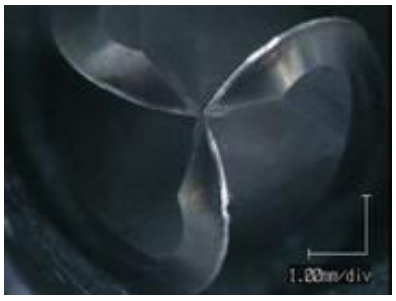
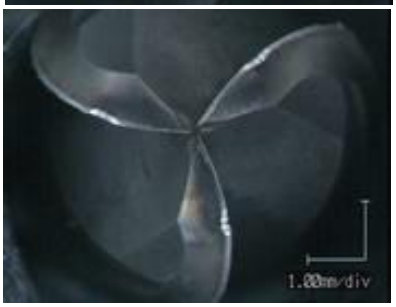
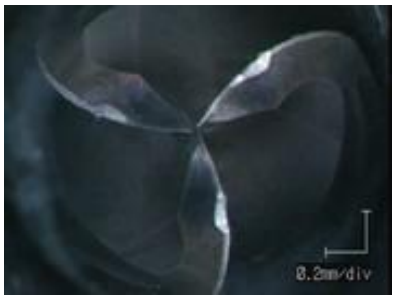
Test Result

Ti-6Al-4V
Work material: Ti-6Al-4V
Milling type: Pocket milling 43 x 43 x 15mm (Wall taper angle: 6deg)
Tool: CFB 3060-0900
Spindle speed: 15,400 [min^{-1}] Feed rate: 3,600 [mm/min] Axial cutting depth: 0.6[mm]
Radial cutting depth: 1.0[mm] (Close to wall part: 0.2 x 4times)
Tool overhang: 20 [mm] Milling time: 21min / 3pockets





Wearing width was measured at the MAX width in 3 flutes.

	HM	UT	ALCRONA
1 Pocket			
2 Pocket			
3 Pocket			
	Wear: 0.220mm	Wear: 0.134mm	Wear: 0.240mm

QR Code For Milling Conditions

For Chrome Cobalt Material

HLS 2000

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

HRRS-S

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

HLRS 2000

Long Neck Radius
Size Ø0.2 - Ø6
Unimax Series Vol. 16 Catalogue: Page 184
Parameters 45 - 55 HRC

HSLB

Long Neck Ball
Size R0.05 - R3
Unimax Series Vol.16 Catalogue: Page 269
Parameters 55 - 62 HRC

2 Flute

C-UMD

Drill

Size Ø0.1 - Ø3

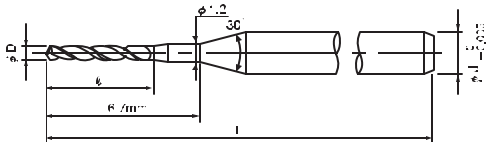
Super MG | MICRO COAT | 24° | Shank Dia 0/-0.005

Number of Flutes	Process			Work Material		
	Roughing	Semi-Finishing	Finishing	Zirconium	Titanium	Chrome Cobalt
2				●	●	

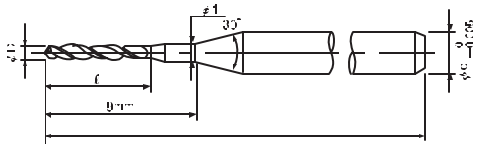
Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)

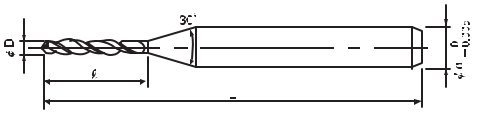
■ φ 0.1 ~ φ 0.25



■ φ 0.26 ~ φ 0.65



■ φ 0.66 ~ φ 3



Diameter tolerance : ØD ≤ 3 : ØD $^{0}_{-0.005}$

Point Angle : 150°

225 Models available: from Ø 0.1 mm to Ø 3 mm by increments of 0.01mm

Unit (mm)

Model Number	Diameter ØD	Flute Length ℓ	Overall Length L	Shank Diameter Ød
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 2014-017	0.14	1.7	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		Zirconium (Use Air blow coolant)			Titanium (Grade 5) (Use oil coolant)		
Diameter (mm)	Recommended Step Ammount (mm)	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	Velocity (m/min)	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	Velocity (m/min)
Ø 0.3	0.1 - 0.2 ØD	7,900	15	5-10	3,000	15	5-10
Ø 0.4	0.1 - 0.2 ØD	7,900	15	5-10	3,000	15	5-10
Ø 0.5	0.1 - 0.2 ØD	7,500	20	10-15	3,500	20	10-15
Ø 0.6	0.1 - 0.2 ØD	7,300	30	10-15	7,300	30	10-15
Ø 0.7	0.1 - 0.2 ØD	8,900	40	15-20	8,900	40	15-20
Ø 0.8	0.1 - 0.2 ØD	8,900	45	15-20	9,500	45	20-25
Ø 0.9	0.1 - 0.2 ØD	8,200	50	15-20	9,000	50	25-28
Ø 1	0.1 - 0.2 ØD	8,400	60	15-20	9,500	50	28-31
Ø 2	0.1 - 0.2 ØD	8,200	100	15-20	5,500	60	31-34
Ø 3	0.1 - 0.2 ØD	2,700	110	20-25	3,500	100	31-34

* 225 models available in total from Diameter 0.1 mm to 3 mm
For more details please ask your distributor.

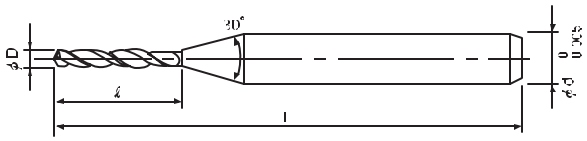
2 Flute

UTDLX

Drill

Size Ø0.3 - Ø3

Number of Flutes	Process			Work Material		
	Roughing	Semi-Finishing	Finishing	Zirconium	Titanium	Chrome Cobalt
2				●	●	



Diameter Tolerance: Ø D 0/-0.01mm
Point Angle : 130°

Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)

Unit (mm)

Model Number	Outside Diameter Ø D	Flute Length ℓ	Overall Length L	Shank Diameter Ø d
UTDLX 2030-045	0.3	4.5	38	3
UTDLX 2035-053	0.35	5.3	38	3
UTDLX 2040-060	0.4	6	38	3
UTDLX 2045-068	0.45	6.8	38	3
UTDLX 2050-075	0.5	7.5	38	3
UTDLX 2055-083	0.55	8.3	38	3
UTDLX 2060-090	0.6	9	45	3
UTDLX 2065-098	0.65	9.8	45	3
UTDLX 2070-105	0.7	10.5	45	3
UTDLX 2075-113	0.75	11.3	45	3
UTDLX 2080-120	0.8	12	45	3
UTDLX 2085-128	0.85	12.8	45	3
UTDLX 2090-135	0.9	13.5	45	3
UTDLX 2095-143	0.95	14.3	45	3
UTDLX 2100-150	1	15	50	3
UTDLX 2105-158	1.05	15.8	50	3
UTDLX 2110-165	1.1	16.5	50	3
UTDLX 2115-173	1.15	17.3	50	3
UTDLX 2120-180	1.2	18	50	3
UTDLX 2125-188	1.25	18.8	50	3
UTDLX 2130-195	1.3	19.5	50	3
UTDLX 2135-203	1.35	20.3	60	3
UTDLX 2140-210	1.4	21	60	3
UTDLX 2145-218	1.45	21.8	60	3
UTDLX 2150-225	1.5	22.5	60	3
UTDLX 2155-233	1.55	23.3	60	3
UTDLX 2160-240	1.6	24	60	3
UTDLX 2165-248	1.65	24.8	60	3
UTDLX 2170-255	1.7	25.5	60	3
UTDLX 2175-263	1.75	26.3	60	3
UTDLX 2180-270	1.8	27	60	3
UTDLX 2185-278	1.85	27.8	60	3
UTDLX 2190-285	1.9	28.5	60	3
UTDLX 2195-293	1.95	29.3	60	3
UTDLX 2200-300	2	30	60	3

Work Material		Zirconium Use Air blow coolant.			Titanium (Grade 5) Use oil coolant		
Diameter (mm)	Recommended Step Amount (mm)	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	Velocity (m/min)	Spindle Speed (min⁻¹)	Feed Rate (mm/min)	Velocity (m/min)
Ø 0.3	0.1 - 0.2 ØD	7,900	10	12-16	6,000	10	5-10
Ø 0.4	0.1 - 0.2 ØD	7,800	15	12-16	6,500	15	5-10
Ø 0.5	0.1 - 0.2 ØD	7,500	25	12-16	7,000	25	10-15
Ø 0.6	0.1 - 0.2 ØD	7,000	30	12-16	7,500	30	10-15
Ø 0.7	0.1 - 0.2 ØD	6,800	50	12-16	8,000	50	15-20
Ø 0.8	0.1 - 0.2 ØD	6,000	70	12-16	8,500	70	20-25
Ø 0.9	0.1 - 0.2 ØD	6,200	80	17-20	9,000	80	25-30
Ø 1	0.1 - 0.2 ØD	6,000	90	17-20	9,500	90	30-35
Ø 2	0.1 - 0.2 ØD	3,200	100	17-20	5,500	100	30-35

55 models available in total from Diameter 0.3mm to 3mm. For more details please ask your distributor.

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