

Tungsten Carbide End Mills

UNIMAX Series

Vol. 1

Dental applications



UNION TOOL



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 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 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:

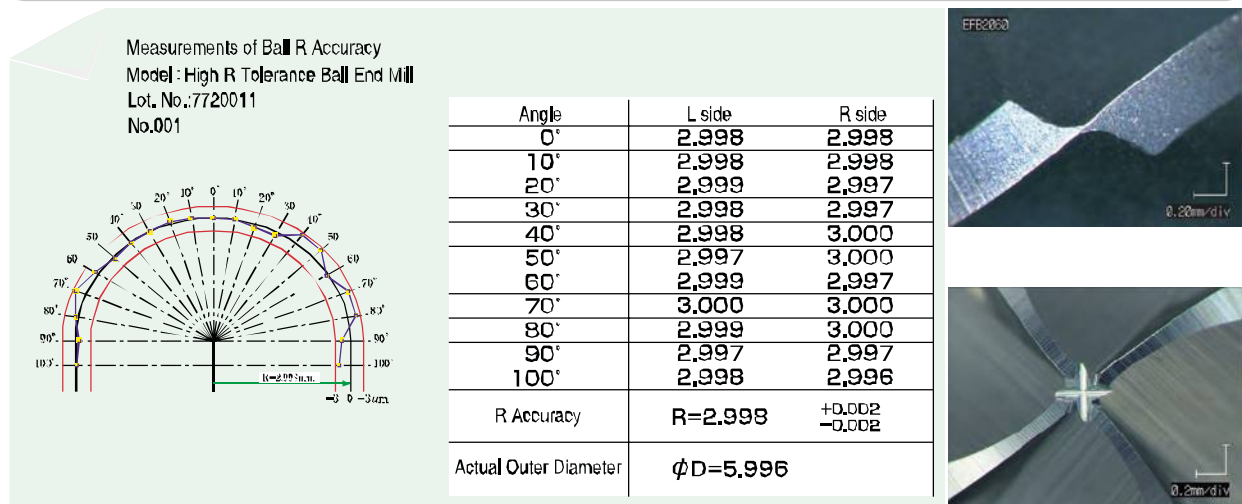
At Union Tool CO., everything is "Made in Japan" - starting from research and development all the way to the design and production of our own unique manufacturing machines which are used to manufacture our products. This guarantees the renowned Japanese quality and precision. Quality controls in all 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.



Exceeding your expectations.

Icon Definitions

unit : mm

Tool Material



Super Micro Grain



Micro Grain

Shank Diameter Tolerance



Tolerance of Shank Diameter : 0/-0,005

Coating



HARDMAX



DIAMOND COAT



UTCOAT



UT MICRO COAT

Ball Radius Tolerance



Ball Radius Tolerance : $\pm 0,005$



Ball Radius Tolerance : $\pm 0,007$



Ball Radius Tolerance : $\pm 0,01$

Helix Angle



Helix Angle 45°



Helix Angle 30°



Helix Angle 24°



Helix Angle 35°

Corner Radius Tolerance



Corner Radius Tolerance : $\pm 0,005$



Corner Radius Tolerance : $\pm 0,015$



Corner Radius Tolerance : $\pm 0,01$

Geometry



Corner Radius Design



Back Taper Geometry



Sharp Corner Design



Variable Pitch



Flatland Design



X Thinning Design

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Alphabetical Order

Model Number	Page	Characteristics
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C

C-UMD	22	2 Flute Drill, <i>with a wide range of sizes</i>
CFLB	18	3 Flute Long Neck Ball, <i>variable pitch, high feed rate</i>
CRRS	10	4 Flute Long Neck Radius, <i>high feed rate, high helix angle</i>

D

DCLB	16	2 Flute long neck ball, <i>diamond coating, long tool life</i>
DCLS	7	2 Flute long neck square, <i>diamond coating, long tool life</i>

H

HLRS 2000	12	2 Flute Long Neck Radius, <i>precise and rigid</i>
HLS 2000	6	2 Flute Long Neck Square, <i>high accuracy for deep milling</i>
HRRS-S	8	4 Flute Long Neck Radius, <i>high efficiency milling</i>
HSLB	14	2 Flute Long Neck Ball, <i>high accuracy for deep milling</i>



U

UTDLX	23	2 Flute Drill, <i>Long Flute, excellent hole accuracy</i>
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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

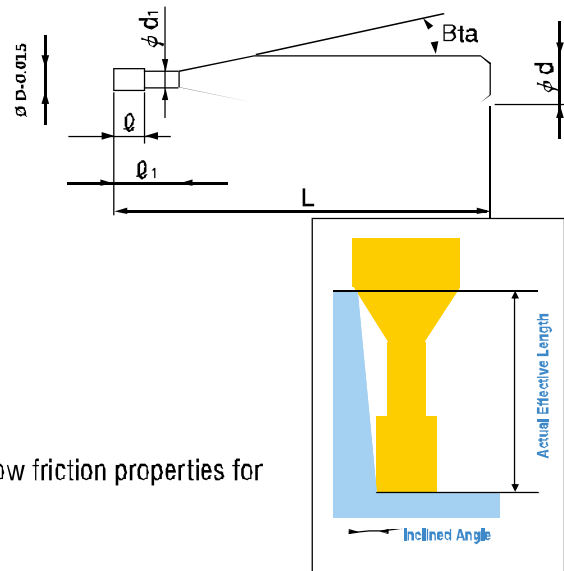
Long Neck Square
Size Ø0.1 - Ø6



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 ØD	Effective Length ℓ ₁	Length of Cut ℓ	Neck Diameter Ød ₁	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Effective Length by inclined angles				
								30°	1°	1°30'	2°	3°
HLS 2005-100	0.5	10	0.7	0.48	16°	50	4	10.82	11.19	11.48	11.72	12.12
HLS 2005-150		15						16.00	16.44	16.78	17.05	17.50
HLS 2010-100	1	10	1.5	0.95	16°	45	4	10.99	11.30	11.78	12.19	13.10
HLS 2010-160		16						17.22	17.78	18.38	19.02	20.44
HLS 2010-200		20						21.35	22.04	22.78	23.57	25.34
HLS 2020-100	2	10	3	1.91	16°	45	4	10.35	10.60	11.05	11.44	12.29
HLS 2020-160		16						16.54	17.08	17.65	18.27	no interference
HLS 2020-200		20						20.67	21.34	22.05	22.82	no interference
HLS 2030-100	3	10	4.5	2.92	16°	45	6	10.35	10.60	11.05	11.43	12.29
HLS 2030-160		16						16.54	17.08	17.65	18.26	19.63
HLS 2030-200		20						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 (mm ⁻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	180	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	400	0.009 - 0.014	0.013
		16	16	14,300	300	0.002 - 0.003	12,100	230	0.003 - 0.006	0.003
		20	20	12,500	200	0.001 - 0.002	10,600	160	0.003 - 0.004	0.002
HLS 2020	2	10	5	21,900	1,680	0.013 - 0.022	12,600	700	0.040 - 0.067	0.200
		16	8	19,500	1,230	0.007 - 0.013	9,400	470	0.024 - 0.039	0.049
		20	10	16,500	750	0.004 - 0.007	8,100	380	0.016 - 0.027	0.025
HLS 2030	3	10	3.5	73,000	2,500	0.027 - 0.046	9,600	930	0.033 - 0.138	1.013
		16	5	22,000	2,200	0.019 - 0.032	7,400	670	0.038 - 0.056	0.247
		20	6.5	17,000	1,800	0.015 - 0.025	6,600	560	0.045 - 0.075	0.127

* 184 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.

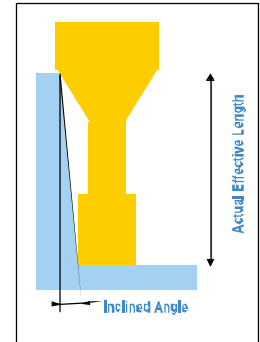
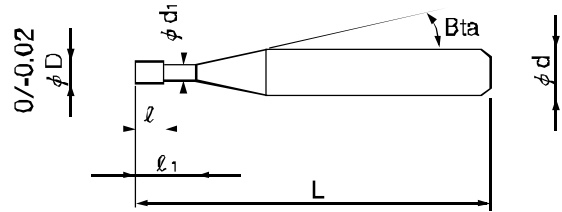
2 Flute

DCLS

Long Neck Square
Size Ø0.4 - Ø6



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 l_1	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	2	0.57	16°	45	4	10.90	11.33	11.71	12.12	13.03
DCLS 2010-100	1	10	2	0.56	16°	45	4	10.91	11.34	11.72	12.13	13.04
DCLS 2010-160		16				50	4	17.16	17.73	18.32	18.96	20.38
DCLS 2010-210		21				55	4	22.33	23.05	23.82	24.65	26.50
DCLS 2015-100	1.5	10	3	1.44	16°	45	4	10.29	10.63	10.98	11.37	12.22
DCLS 2015-160		16				50	4	16.48	17.02	17.59	18.20	19.56
DCLS 2015-210		21				55	4	21.64	22.34	23.09	23.89	no reference
DCLS 2020-100	2	10	4	1.9	16°	50	4	10.35	10.68	11.04	11.43	12.28
DCLS 2020-160		16				50	4	16.53	17.07	17.65	18.26	no reference
DCLS 2020-210		21				55	4	21.69	22.40	23.15	23.95	no reference
DCLS 2030-160	3	16	6	2.9	16°	70	6	16.53	17.07	17.65	18.26	19.63
DCLS 2030-320		32				80	6	33.04	34.11	35.25	36.48	no reference

Work Material				Zirconium <small>Use Air blow coolant.</small>			Titanium (Grade 5)			Radial Depth
Model Number	Outside Diameter	Effective Length	L/D	Speed (mm ⁻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 2006	0.6	10	16	24,000	120	0.6	N/A	N/A	N/A	0.025
DCLS 2010	1	10	10	21,100	530	1	N/A	N/A	N/A	0.05
		16	16	14,300	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	600	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	1,650	2	N/A	N/A	N/A	0.1
		16	6	19,500	1,730	2	N/A	N/A	N/A	0.1
		21	10	16,500	750	2	N/A	N/A	N/A	0.1
DCLS 2030	3	16	5	22,000	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

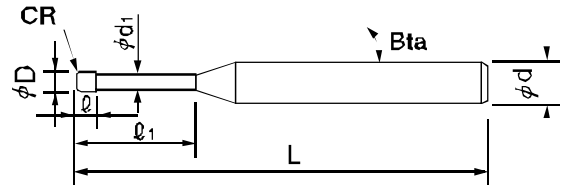
Long Neck Radius
Size Ø2 - Ø12



Ø2 -- Ø6

Ø8 -- Ø12

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 ØD	Corner Radius CR	Effective Length L ₁	Length of Cut L	Neck Diameter Ød ₁	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød
HRRS 4020-03-06S	2	R0.3	6	2	1.91	16°	45	4
HRRS 4020-05-06S	2	R0.5	6	2	1.91	16°	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

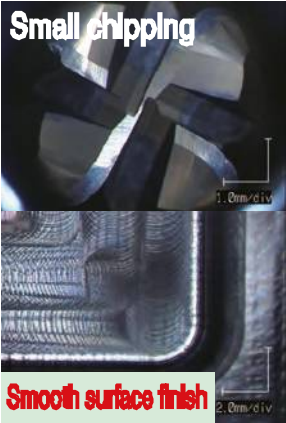


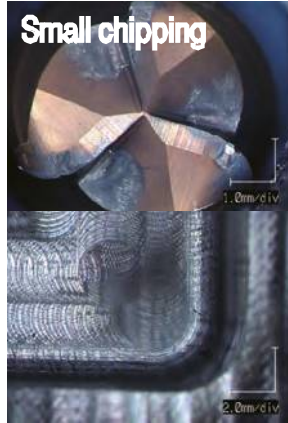
For Chrome Cobalt Milling Condition please refer to page 204: Hardened Steels 45-55 HRC in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 21)

Work Material			Zirconium Use Air Blow coolant.				Titanium (Grade 5) Side milling. Use oil coolant.			
Model Number	Outside Diameter (mm)	Length of Cut	Spindle Speed (min ⁻¹)	Feed (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)
HRRS 4020-03-06S	2	2	30,000	7,200	0.04	0.66	8,000	700	1.0	0.05
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	0.2

*26 models available in total 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
 <p>Small chipping</p> <p>Smooth surface finish</p>	 <p>Broken</p> <p>Broken after 3 mins</p>	 <p>Chipping</p>	 <p>Small chipping</p>
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

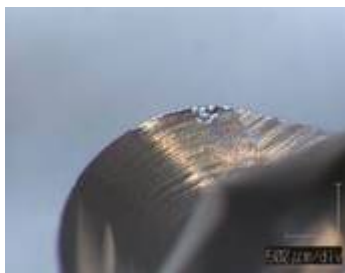
Original Corner Radius Design Offers High Rigidity and Reduces Cutting Force

After milling SKD11 (60HRC)

HRRS

Competitor

Competitor



Seamless corner radius with equal rake angle design. Reduce the cutting force and offers excellent chip evacuation to protect from the tool damage.



Flat and non-helix gash design. Badly damaged at tip point where cutting chips are trapped by poor chip evacuation.



Flat and helical gash design. Huge tool damage at tangent point where the gash shape abruptly changed and cutting chips could not evacuate properly.

Spindle Speed : 2,700min⁻¹
 Feed Rate : 2,000mm/min

Axial Depth : 0.3mm
 Radial Depth : 1.5mm

Overhang : 20mm
 Pocket Size : 40mm x 40mm x 0.3mm

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

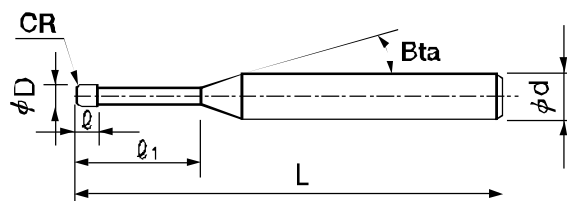
4 Flute

CRRS

Long Neck Radius
Size $\varnothing 2 - \varnothing 12$



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 $\varnothing D$	Corner Radius CR	Effective Length \varnothing_1	Length of Cut \varnothing_2	Neck Diameter $\varnothing d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\varnothing d$
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)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed (mm/min)	a_p Axial Depth (mm)	a_e 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.

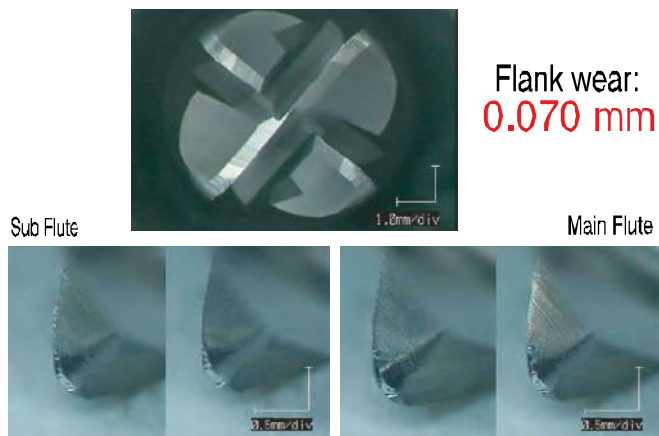
For more details please ask your distributor.

*N/A : Non Applicable

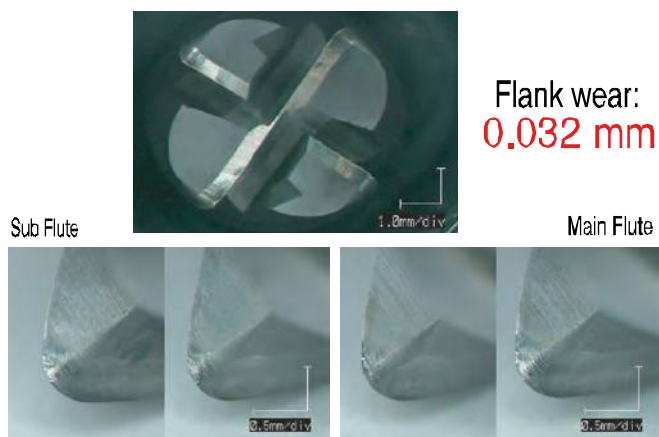
4 Flute

Milling Example: Pocket Milling by Different Work Materials Tool: CRRS($\varnothing 6 \times CR0.5$)

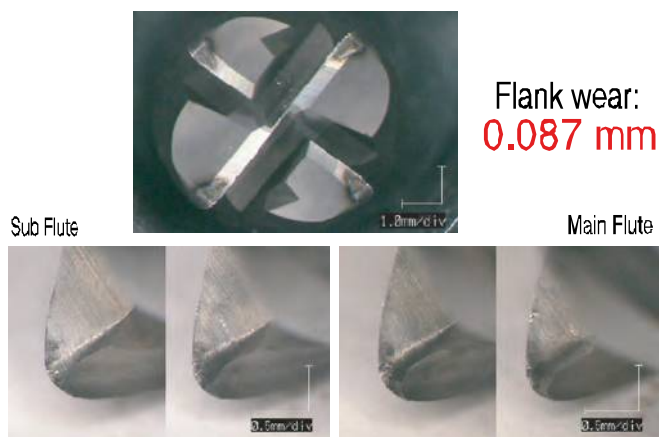
Work Material	S50C
Spindle Speed	10,000min ⁻¹
Feed Rate	12,000mm/min
Axial Depth a_p	0,14mm
Radial Depth a_e	2,4mm
Overhang	24mm
Work Material Size	95mm×90mm×18mm (X×Y×Z)
Cycle Time	90 minutes
Coolant	Air Blow (Nozzle)



Work Material	SUS304
Spindle Speed	10,000min ⁻¹
Feed Rate	7,200mm/min
Axial Depth a_p	0,07mm
Radial Depth a_e	1,98mm
Overhang	24mm
Work Material Size	90mm×44mm×18mm (X×Y×Z)
Cycle Time	84 minutes
Coolant	Water Soluble



Work Material	STAVAX (52HRC)
Spindle Speed	8,000min ⁻¹
Feed Rate	5,250mm/min
Axial Depth a_p	0,07mm
Radial Depth a_e	1,75mm
Overhang	24mm
Work Material Size	95mm×25mm×12mm (X×Y×Z)
Cycle Time	56 minutes
Coolant	Oil Mist



2 Flute

HLRS 2000

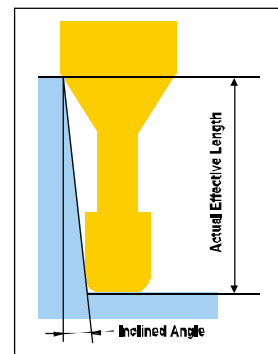
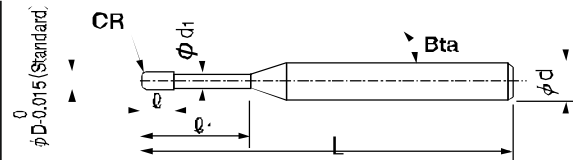
Long Neck Radius
Size $\varnothing 0.2 - \varnothing 6$



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 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 $\varnothing D$	Corner Radius CR	Effective Length ℓ_1	Length of cut ℓ	Neck Diameter $\varnothing d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\varnothing d$
HLRS 2008-005-060	0.8	R0.05	6	0.8	0.78	16°	50	4
HLRS 2008-005-080			8					
HLRS 2010-005-100			10					
HLRS 2010-005-160	1.0	R0.05	16	1	0.95	16°	50	4
HLRS 2010-005-200			20				60	
HLRS 2010-01-100			10				50	
HLRS 2010-01-160			16				60	
HLRS 2010-01-200	1.2	R0.1	20	1.2	1.14	16°	60	4
HLRS 2012-02-120			12				55	
HLRS 2012-02-200			20				60	
HLRS 2015-005-100	1.5	R0.05	10	1.5	1.45	16°	50	4
HLRS 2015-01-100		R0.1	10				55	
HLRS 2015-01-160			16				60	
HLRS 2015-01-200			20				60	
HLRS 2020-005-100	2.0	R0.05	10	2	1.92	16°	50	4
HLRS 2020-01-100		R0.1	10				55	
HLRS 2020-01-160			16				60	
HLRS 2020-01-200			20				60	
HLRS 2025-01-100	2.5	R0.1	10	2.5	2.42	16°	50	4
HLRS 2025-01-200			20				60	
HLRS 2030-01-120	3	R0.1	12	3	2.92	16°	55	6
HLRS 2030-01-160			16				60	
HLRS 2030-01-200			20				60	
HLRS 2030-02-120		R0.2	12				55	
HLRS 2030-02-160			16				60	
HLRS 2030-02-200			20				60	

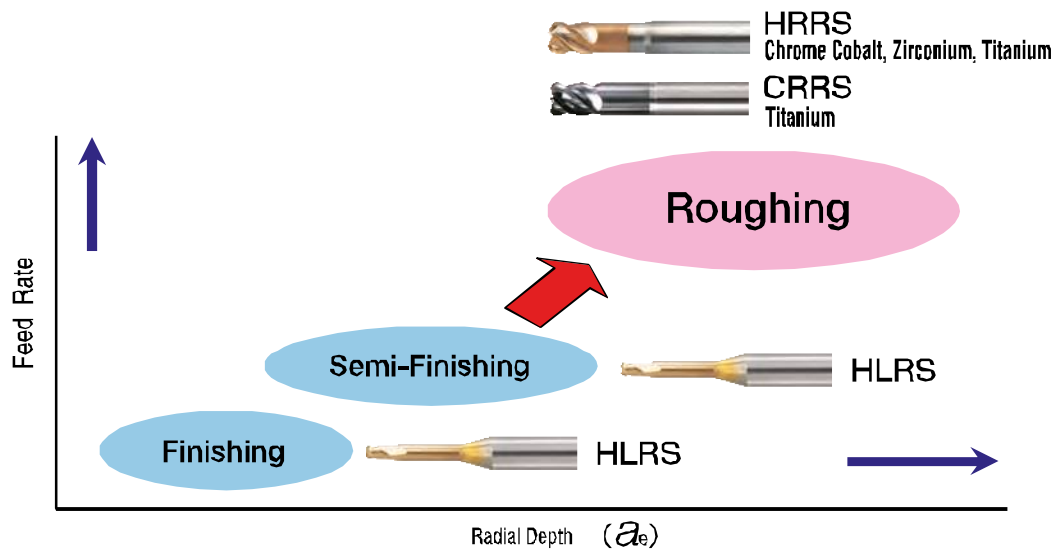
* 351 models available in total from Diameter 0.2mm to 6mm with various corner radius from 0.05mm to 1mm.
For more details please ask your distributor.

2 Flute

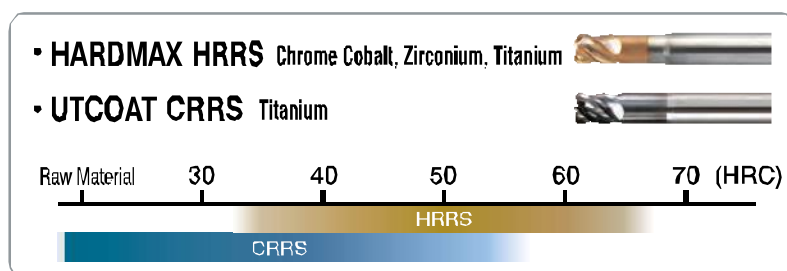
For Chrome Cobalt Milling Condition please refer to page 184 : Hardened Steels 45-55 HRC in our UNIMAX Series Vol. 16 Catalogue (QR CODE page 21)

Work Material				Zirconium <small>Use Air blow coolant.</small>			Titanium (Grade 5) <small>Use Oil coolant.</small>			Radial Depth
Model Number	Outside Diameter	Effective Length	L/D	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	Axial Depth a_p (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	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	0.108
		8	10	7,600	20	0.002	22,000	200	0.018	0.090
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	0.027
		20	20	3,900	13	0.001	15,000	180	0.020	0.018
HLRS 2012	1.2	12	10	4,500	638	0.004	15,000	300	0.030	0.072
		20	16.6	3,500	22	0.002	13,000	200	0.020	0.018
HLRS 2015	1.5	10	6.6	6,000	85	0.023	13,000	300	0.040	0.288
		16	10.6	4,700	58	0.011	12,300	250	0.035	0.180
		20	13.3	4,200	46	0.003	11,600	200	0.030	0.108
HLRS 2020	2	10	5	7,600	113	0.028	10,000	350	0.060	0.585
		16	8	5,900	90	0.023	9,000	300	0.050	0.315
		20	10	5,300	84	0.014	8,000	250	0.040	0.198
HLRS 2025	2.5	10	4	8,400	154	0.048	7,500	350	0.070	0.540
		20	8	6,300	91	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	5.3	7,900	173	0.054	6,000	350	0.060	0.630
		20	6.6	7,100	150	0.044	5,000	300	0.050	0.600

Usage of Radius Series



4 Flute Active Corner Radius End Mill's Target Hardness



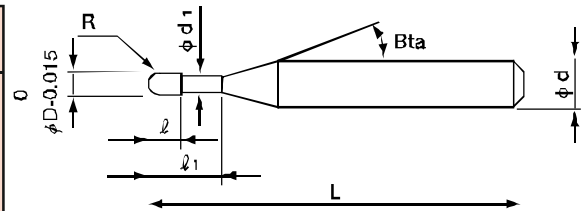
2 Flute

HSLB

Long Neck Ball
Size R0.05 - R3



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 ℓ ₁	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	6
HSLB 2060-150	R3	15	4.8	16°	80	6
HSLB 2060-200	R3	20	4.8	16°	80	6

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

Work Material			Zirconium <small>Use air blow coolant.</small>				Titanium (Grade 5) <small>Use Oil coolant.</small>			
Model Number	Radius of Ball Nose (mm)	Length of Cut	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a _p Axial Depth (mm)	a _e Radial Depth (mm)
HSLB 2010-100	R0.5	10	33,500	1,500	0.16	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	0.46	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	0.040
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	1.3	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

* 292 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



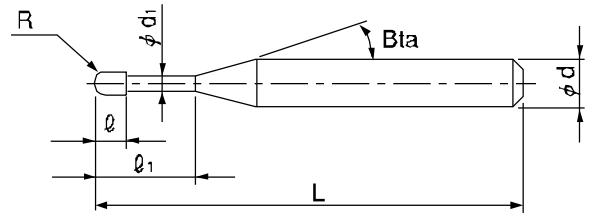
2 Flute

DCLB

Long Neck Ball
Size R0.2 - R3



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 l_1	Length of cut l	Shank Taper Angle Bta	Overall Length L	Shank Diameter ϕd
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	6

Model Number	Work Material		Zirconium <small>Use Air blow coolant.</small>				Titanium (Grade 5) <small>Use Oil coolant.</small>			
	Radius of Ball Nose (mm)	Length of Cut	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a_r Axial Depth (mm)	a_e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)
DCLB 2010-0100	R0.5	10	33,500	1,500	0.16	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	0.10	0.10	N/A	N/A	N/A	N/A
DCLB 2020-0100	R1	10	27,000	1,500	0.46	0.20	N/A	N/A	N/A	N/A
DCLB 2020-0160	R1	16	27,000	1,500	0.38	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

* 64 models available in total from Radius R0.2 mm to R3 mm with effective length from 4 to 40 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



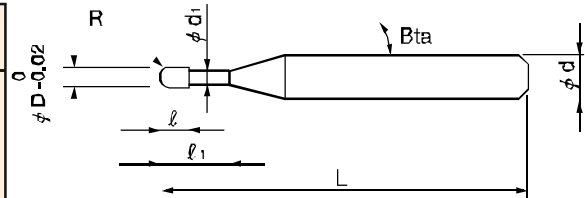
3 Flute

CFLB

Long Neck Ball
Size R0.3 - R3



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 chatter.

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 l_1	Length of Cut l	Shank Taper Angle Bta	Overall Length L	Shank Diameter ϕd
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 coolant.				Titanium (Grade 5) Use oil coolant.			
Model Number	Radius of Ball Nose (mm)	Effective Length (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Spindle Speed (min ⁻¹)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)
CFLB 3015-100	R0.75	10	N/A	N/A	N/A	N/A	16,000	2,000	0.025	0.19
CFLB 3020-100	R1	10	N/A	N/A	N/A	N/A	18,000	3,000	0.100	0.43
CFLB 3020-160	R1	16	N/A	N/A	N/A	N/A	8,400	1,200	0.050	0.34
CFLB 3030-100	R1.5	10	N/A	N/A	N/A	N/A	16,000	4,000	0.150	0.65
CFLB 3030-160	R1.5	16	N/A	N/A	N/A	N/A	11,200	2,800	0.135	0.62
CFLB 3030-200	R1.5	20	N/A	N/A	N/A	N/A	8,000	2,000	0.120	0.58
CFLB 3040-120	R2	12	N/A	N/A	N/A	N/A	12,000	4,000	0.200	0.87
CFLB 3040-160	R2	16	N/A	N/A	N/A	N/A	10,800	3,600	0.200	0.87
CFLB 3040-200	R2	20	N/A	N/A	N/A	N/A	9,000	3,000	0.200	0.87

* 32 models available in total from Radius R0.3 mm to R3 mm with 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

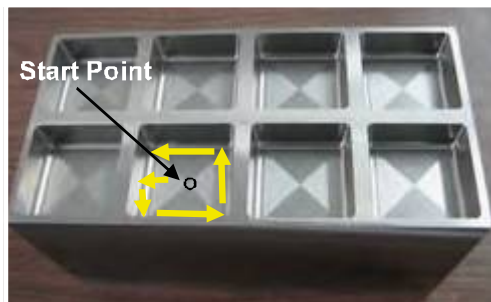
Milling type: Pocket milling 43 x 43 x 15mm (Wall taper angle: 6deg)

Tool: CFB 3060-0900

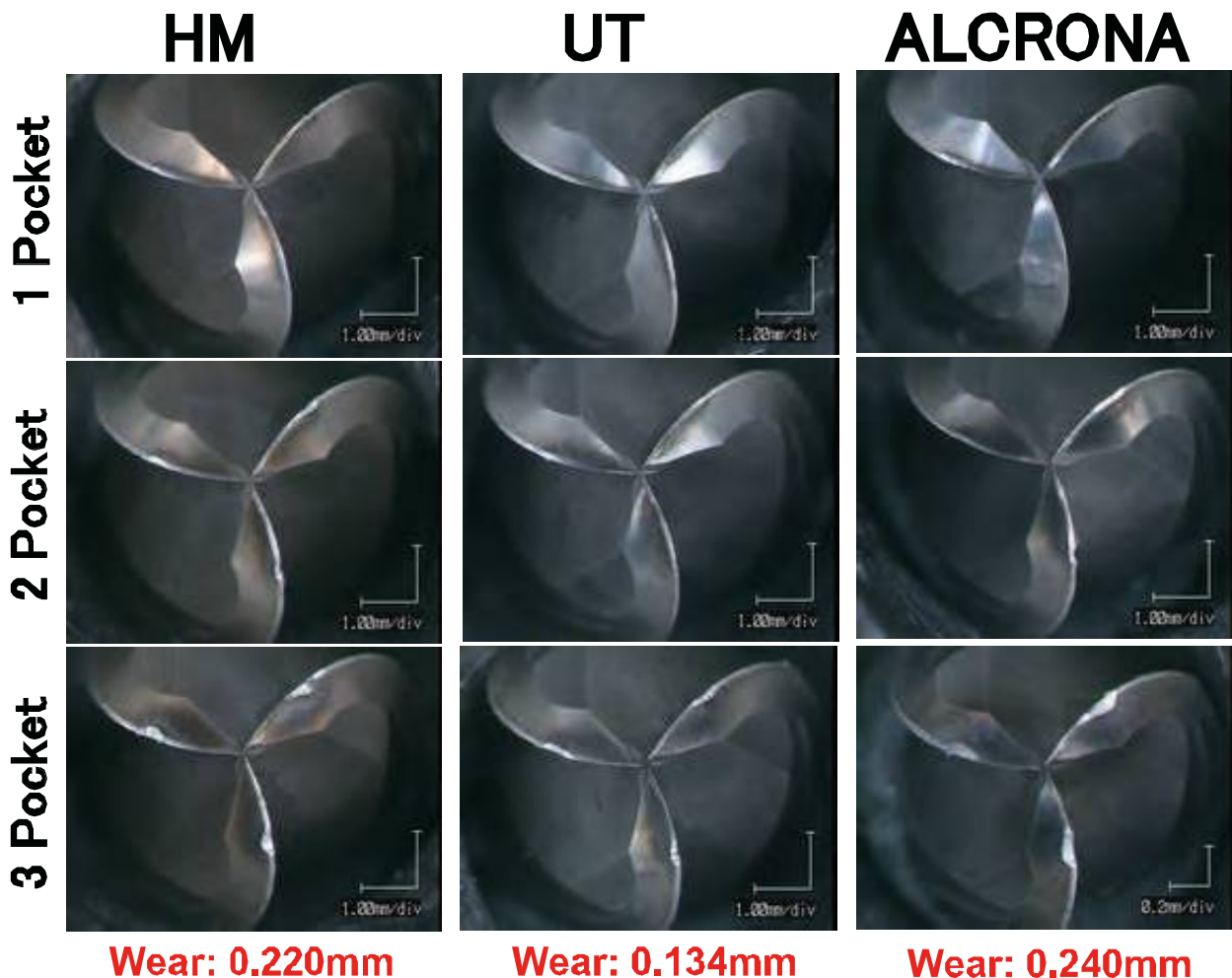
Spindle speed: 15,400 [min⁻¹] Feed rate: 3,600 [mm/min] Axial cutting depth: 0.6[mm]

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.



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 $\varnothing 0.1 - \varnothing 3$



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

Applicable Work Material (● most suitable, ● suitable)

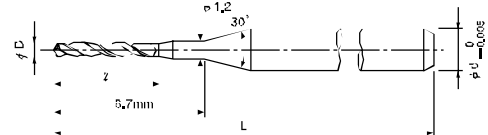
Applicable Process (■ most suitable, ■ suitable)

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

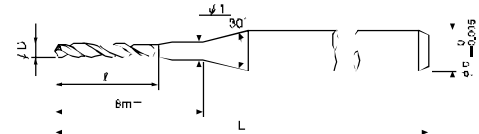
Point Angle : 150°

225 Models available: from $\varnothing 0.1$ mm to $\varnothing 3$ mm by increments of 0.01mm

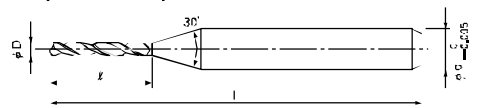
■ $\varnothing 0.1 \sim \varnothing 0.25$



■ $\varnothing 0.26 \sim \varnothing 0.65$



■ $\varnothing 0.66 \sim \varnothing 3$



Unit (mm)

Model Number	Diameter $\varnothing D$	Flute Length \varnothing	Overall Length L	Shank Diameter $\varnothing d$
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		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)
$\varnothing 0.3$	0.1 - 0.2 $\varnothing D$	7,900	10	5-10	6,000	10	5-10
$\varnothing 0.4$	0.1 - 0.2 $\varnothing D$	7,800	15	5-10	6,000	15	5-10
$\varnothing 0.5$	0.1 - 0.2 $\varnothing D$	7,500	20	10-15	6,500	20	10-15
$\varnothing 0.6$	0.1 - 0.2 $\varnothing D$	7,000	30	10-15	7,000	30	10-15
$\varnothing 0.7$	0.1 - 0.2 $\varnothing D$	6,800	40	15-20	8,000	40	15-20
$\varnothing 0.8$	0.1 - 0.2 $\varnothing D$	6,000	45	15-20	8,500	45	20-25
$\varnothing 0.9$	0.1 - 0.2 $\varnothing D$	6,200	50	15-20	9,000	50	25-28
$\varnothing 1$	0.1 - 0.2 $\varnothing D$	6,400	60	15-20	9,500	50	28-31
$\varnothing 2$	0.1 - 0.2 $\varnothing D$	3,200	100	15-20	5,500	80	31-34
$\varnothing 3$	0.1 - 0.2 $\varnothing D$	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

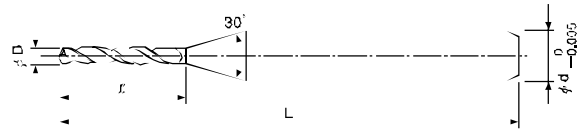
UTDLX

Drill

Size $\varnothing 0.3 - \varnothing 3$



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



Diameter Tolerance: $\varnothing D 0/-0.01\text{mm}$

Point Angle : 130°

Applicable Work Material (● most suitable, ● suitable)

Applicable Process (■ most suitable, ■ suitable)

Unit (mm)

Model Number	Outside Diameter $\varnothing D$	Flute Length l	Overall Length L	Shank Diameter $\varnothing d$
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
UTDI X 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 <small>Use Air blow coolant.</small>			Titanium (Grade 5) <small>Use oil coolant.</small>		
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)
$\varnothing 0.3$	0.1 - 0.2 $\varnothing D$	7,900	10	12-16	6,000	10	5-10
$\varnothing 0.4$	0.1 - 0.2 $\varnothing D$	7,800	15	12-16	6,500	15	5-10
$\varnothing 0.5$	0.1 - 0.2 $\varnothing D$	7,500	25	12-16	7,000	25	10-15
$\varnothing 0.6$	0.1 - 0.2 $\varnothing D$	7,000	30	12-16	7,500	30	10-15
$\varnothing 0.7$	0.1 - 0.2 $\varnothing D$	6,800	50	12-16	8,000	50	15-20
$\varnothing 0.8$	0.1 - 0.2 $\varnothing D$	6,000	70	12-16	8,500	70	20-25
$\varnothing 0.9$	0.1 - 0.2 $\varnothing D$	6,200	80	17-20	9,000	80	25-30
$\varnothing 1$	0.1 - 0.2 $\varnothing D$	6,000	90	17-20	9,500	90	30-35
$\varnothing 2$	0.1 - 0.2 $\varnothing D$	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.

UNION TOOL GROUP

HEADQUARTERS

6-17-1 Minami-Ohi, Shinagawa-ku, Tokyo, JAPAN
Tel: + 81-3-5493-1023

NAGAOKA FACTORY TECHNICAL CENTER

2706-6 Togawa, Settaya-machi, Nagaoka-shi, Niigata 940-1104
JAPAN

MITSUKE FACTORY

3-1 Shinko-cho, Mitsuke-shi, Niigata 954-0076, JAPAN

UNION TOOL EUROPE S.A.

Avenue des Champs-Montanis 14a, CH-2074
Marin / Neuchâtel, SWITZERLAND
Tel: + 41-32-756-6633 Fax: + 41-32-756-6634

Austria

Six Sigma Tools
www.sixsigmatools.ch

Belgium

DIATool BVBA
www.diatool.be

Czech Republic, Slovakia

CKP Churilín A.S.
www.ckpchurilin.cz

Denmark, Sweden

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www.varbus.dk

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DY FMS-TOOL AB
www.fms-tools.fi

France

A.G.R.
www.agr-afutage.fr

France

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www.dcm.fr

Germany

Schreurs Tools GmbH
www.schreurs-tools.de

Greece

Pantechical
pantechical@toneLgr

Italy

TTE srl
www.ttetecl.it

Netherlands

SVM
www.svmreestechiek.nl

Norway

A.S. NOR-SWISS
norewisa@norswiss.no

Portugal

MAFAPRE
www.mafapre.pt

Russia

REZER Engineering LLC
rezer@rezer.ru

Russia

RTS Engineering Ltd.
www.rts-engineering.ru

Serbia

PRECIZNI ALTI
precision.srb@gmail.com

Spain

IMCAR
www.imcar.com

Switzerland

Six Sigma Tools
www.sixsigmatools.ch

Turkey

DEMIRAL Makina INS.
www.demiralmakina.com

United Kingdom, Republic of Ireland

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UNION TOOL EUROPE S.A.
www.uniontool.com info@uniontool.com