UNION TOOL

Tungsten Carbide End Mills
UNIMAX Series

NEW
Published April 2023

DLCCOAT 2 Flutes End Mills for Copper Electrode Milling

DLCLB
Long Neck Ball End Mills

new
DLCLS
Long Neck Square End Mills

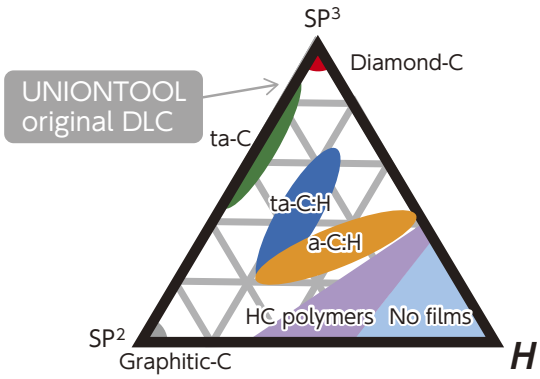
new
DLCLRS
Long Neck Radius End Mills

UNION TOOL CO.

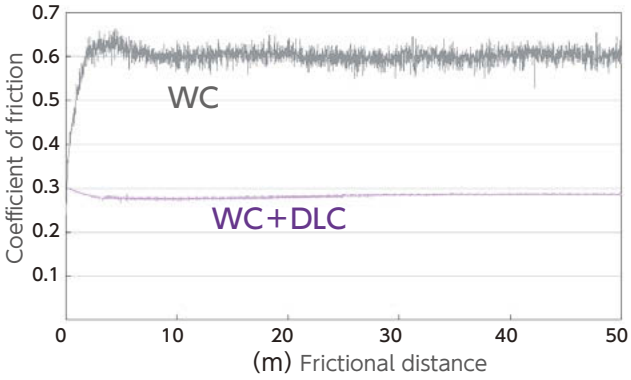
Our in-house developed DLC Coating

Diamond-like hardness (around 4,000 – 6,000HV)

Hardness of normal coating for Steels is 3,000 – 4,000HV

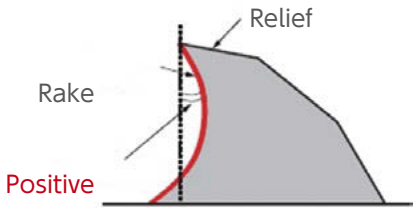


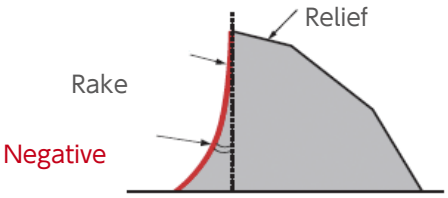
Excellent lubricity and high resistance to welding
Best for Copper and Aluminum milling



Coating thickness suited for sharp cutting edges
Thinner than normal coating for Steels

Sharp Cutting Edge





DLC Series

Rake and relief angle are designed for copper milling
Sharp cutting edge reduces burrs on milling surface

Normal Cutting Edge for Hard Materials

Negative rake angle for chipping resistance

Higher Grade Precision

DLCLB

Long Neck Ball

Radius of Ball Nose	D ≦ R0.5	D > R0.5
Diameter Tolerance	0/-0.006	0/-0.01

Radius of Ball Nose	R0.05~R0.2	R0.25~R2	R3
Radius Accuracy	± 0.002	± 0.003	± 0.004
Shank Diameter Tolerance	0/-0.004		

DLCLRS

Long Neck Radius

Outside Diameter	Ø0.2~Ø3
Diameter Tolerance	0/-0.005
CR Tolerance	± 0.005
Shank Diameter Tolerance	0/-0.004

DLCLS

Long Neck Square

Outside Diameter	Ø0.1~Ø3
Diameter Tolerance	0/-0.005
Shank Diameter Tolerance	0/-0.004

Unit (mm)

DLCLB
Milling example

Cu30 : W70
Tungsten Copper

Work Size 50 × 50 × 50 mm
Coolant: Oil Mist

DLCLB series
Housing-rib
Electrode Milling Video

No	Milling Process	Tool	Spindle Speed (min^{-1})	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Allowance (mm)	Cycle Time (h:m:s)
1	Roughing	**R1.5 × EL10**	12,000	1,800	0.6	1.2	0.1	0:19:07
2	Roughing	**R0.75 × EL6**	21,300	1,530	0.3	0.6	0.1	0:21:34
3	Semi-finishing Flat surface	**R1 × EL6**	14,000	1,250	0.05	0.1	0.05	0:32:15
4	Semi-finishing Convex Pocket	**R0.5 × EL5**	29,500	1,530	0.05	0.06	0.05	1:43:09
5	Semi-finishing Corner	**R0.4 × EL6**	21,800	550	0.06	0.06	0.05	1:10:33
6	Finishing Flat surface	**R1 × EL6**	14,000	1,250	0.05	0.04	0	1:25:15
7	Finishing Convex Pocket	**R0.5 × EL5**	29,500	1,530	0.05	0.028	0	1:37:19
8	Finishing Cylinder corner	**R0.3 × EL5**	24,000	330	0.0002 Cusp Height	0.0002 Cusp Height	0	4:54:10

Total 12:03:22

DLC coating off ers high wear resistance and is suited even for Tungsten Copper that is hard to mill.

DLCLB
Milling example

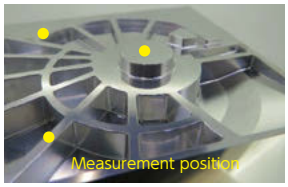
A7075
Aluminum

Work Size 50 × 50 × 50 mm
Coolant: Water Soluble

Reflection of the background

The surface finish is of such high quality that the letters refl ect perfectly in it.

Surface roughness



Ra 0.03 μm
Average of 3 positions
Ra 0.03 μm

No	Milling Process	Tool	Spindle Speed (min^{-1})	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Allowance (mm)	Cycle Time (h:m:s)
1	Roughing	**R1.5 × EL10**	15,000	2,550	0.6	1.2	0.1	0:17:49
2	Roughing	**R0.75 × EL6**	25,500	2,040	0.3	0.6	0.1	0:20:22
3	Semi-finishing Flat surface	**R1 × EL6**	18,700	2,100	0.05	0.1	0.05	0:25:06
4	Semi-finishing Convex Pocket	**R0.5 × EL5**	30,000	1,700	0.05	0.06	0.05	0:53:17
5	Semi-finishing Corner	**R0.4 × EL6**	30,000	1,000	0.06	0.06	0.05	0:17:02
6	Finishing Flat surface	**R1 × EL6**	18,700	2,100	0.05	0.04	0	1:06:03
7	Finishing Convex Pocket	**R0.5 × EL5**	30,000	1,700	0.05	0.028	0	1:31:32
8	Finishing Cylinder corner	**R0.3 × EL5**	30,000	650	0.0002 Cusp Height	0.0002 Cusp Height	0	2:40:18

Total 7:31:29

Suited even for Aluminum milling as the cutting edge is sharper than normal endmills for Steels.

DLCLB

DLCCOAT 2 Flute Long Neck Ball End Mills for Copper Electrode Milling

R0.05～R3

Super MG | DLC | 30° | R ±0.002 (R0.05～R0.2) | R ±0.003 (R0.25～R2) | R ±0.004 (R3) | Shank Dia 0/-0.004 | Back Taper Geometry

Back taper geometry does not apply to R0.15 or below.

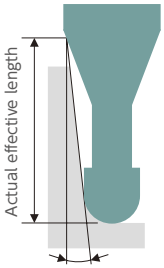
Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

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

Unit (mm)

Radius of Ball Nose	D ≦ R0.5	D > R0.5
Diameter Tolerance	0/-0.006	0/-0.01

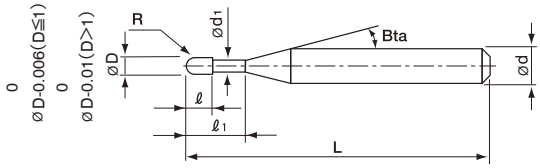
Radius of Ball Nose	R0.05～R0.2	R0.25～R2	R3
Radius Accuracy	± 0.002	± 0.003	± 0.004



Label Sample

#001 ØD0.597 R+0.001/−0.001

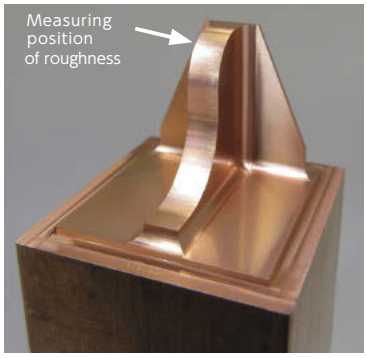
Diameter and Ball Radius accuracy measurements are printed on the label to support High Precision milling.



The shank taper angle shown is not an exact value.

Milling Example of Copper Electrode Model
DLCLB R1 × EL16

C1100
Tough Pitch Copper



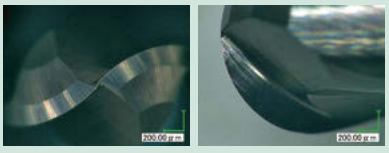
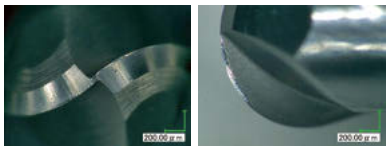
Milling Process	Spindle Speed (min^{-1})	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Cycle Time (h:m:s)
Roughing	10,800	1,090	0.25	0.5	1:31:59
Semi-finishing	10,800	1,090	0.05	0.05	1:31:15
Finishing	13,090	545	0.0001 Cusp Height	0.03	1:15:26

Total 4:18:40

Work Size 20 × 20 × D 16 mm

Milling Method Contouring
Overhang Length 24 mm
Coolant Oil Mist

DLCLB series Introduction Video

DLCLB R1 × EL16	R1 × EL16 Conventional
Tool after milling (4h)	Tool after milling (4h)
	
45° Inclined surface Ra **0.18** μm	45° Inclined surface Ra **0.22** μm

DLCLB has less wear and damage after 4 hours of milling.

DLCCOAT 2 Flute Long Neck Ball End Mills for Copper Electrode Milling

Total 71 models

Unit (mm)

Model Number	Radius of Ball Nose R	Effective Length ℓ_1	Length of Cut ℓ	Neck Diameter $\varnothing d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\varnothing d$	Suggested Retail Price ¥	Effective Length by Inclined Angles				
									30′	1°	1°30′	2°	3°
DLCLB 2001-003	**R0.05**	0.3	0.08	0.095	11°	45	4	10,600	0.34	0.36	0.39	0.41	0.46
DLCLB 2001-005		0.5				45	4	11,000	0.55	0.59	0.62	0.65	0.73
DLCLB 20015-003	**R0.075**	0.3	0.12	0.14	11°	45	4	11,700	0.36	0.38	0.40	0.42	0.47
DLCLB 20015-005		0.5				45	4	12,400	0.57	0.60	0.63	0.66	0.74
DLCLB 20015-010		1				45	4	12,900	1.09	1.15	1.21	1.27	1.43
DLCLB 2002-003	**R0.1**	0.3	0.16	0.19	11°	45	4	8,500	0.41	0.43	0.45	0.47	0.53
DLCLB 2002-005		0.5				45	4	8,500	0.62	0.65	0.68	0.72	0.80
DLCLB 2002-010		1				45	4	8,900	1.14	1.20	1.26	1.33	1.49
DLCLB 2002-015		1.5				45	4	9,200	1.67	1.75	1.84	1.94	2.17
DLCLB 2003-006	**R0.15**	0.6	0.24	0.29	11°	45	4	8,900	0.72	0.75	0.79	0.83	0.92
DLCLB 2003-010		1				45	4	8,900	1.14	1.19	1.25	1.32	1.47
DLCLB 2003-015		1.5				45	4	9,200	1.67	1.74	1.83	1.93	2.15
DLCLB 2003-020		2				45	4	9,600	2.19	2.29	2.41	2.53	2.84
DLCLB 2004-010	**R0.2**	1	0.32	0.39	11°	45	4	7,700	1.14	1.19	1.24	1.30	1.45
DLCLB 2004-020		2				45	4	7,900	2.19	2.29	2.40	2.52	2.82
DLCLB 2004-030		3				45	4	8,000	3.23	3.39	3.56	3.74	4.19
DLCLB 2004-040		4				45	4	8,200	4.28	4.49	4.71	4.96	5.56
DLCLB 2005-010	**R0.25**	1	0.4	0.49	11°	45	4	7,600	1.14	1.18	1.24	1.29	1.43
DLCLB 2005-020		2				45	4	7,600	2.18	2.28	2.39	2.51	2.80
DLCLB 2005-030		3				45	4	7,700	3.23	3.38	3.55	3.73	4.17
DLCLB 2005-040		4				45	4	7,900	4.28	4.48	4.70	4.95	5.54
DLCLB 2005-050		5				45	4	8,000	5.33	5.58	5.86	6.17	6.91
DLCLB 2006-010	**R0.3**	1	0.48	0.59	11°	45	4	5,900	1.14	1.18	1.23	1.28	1.41
DLCLB 2006-020		2				45	4	5,900	2.18	2.28	2.38	2.50	2.78
DLCLB 2006-030		3				45	4	6,100	3.23	3.38	3.54	3.72	4.15
DLCLB 2006-040		4				45	4	6,200	4.28	4.48	4.70	4.94	5.52
DLCLB 2006-050		5				45	4	6,400	5.32	5.57	5.85	6.16	6.89
DLCLB 2006-060		6				45	4	6,500	6.37	6.67	7.01	7.38	8.26
DLCLB 2008-020	**R0.4**	2	0.64	0.79	11°	45	4	6,100	2.18	2.27	2.37	2.48	2.75
DLCLB 2008-030		3				45	4	6,100	3.22	3.37	3.52	3.70	4.12
DLCLB 2008-040		4				45	4	6,200	4.27	4.47	4.68	4.92	5.48
DLCLB 2008-060		6				45	4	6,400	6.37	6.66	6.99	7.36	8.22
DLCLB 2008-080		8				45	4	6,500	8.46	8.86	9.30	9.79	10.96
DLCLB 2010-020	**R0.5**	2	0.8	0.98	11°	45	4	5,800	2.19	2.28	2.37	2.48	2.73
DLCLB 2010-030		3				45	4	5,800	3.24	3.37	3.53	3.70	4.10
DLCLB 2010-040		4				45	4	5,800	4.28	4.47	4.68	4.92	5.47
DLCLB 2010-050		5				45	4	5,900	5.33	5.57	5.84	6.14	6.84
DLCLB 2010-060		6				45	4	5,900	6.38	6.67	6.99	7.35	8.21
DLCLB 2010-080		8				45	4	6,200	8.47	8.87	9.31	9.79	10.95
DLCLB 2010-100		10				45	4	6,200	10.57	11.07	11.62	12.23	13.68
DLCLB 2010-120		12				45	4	6,200	12.66	13.26	13.93	14.67	16.42

DLCCOAT 2 Flute Long Neck Ball End Mills for Copper Electrode Milling

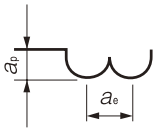
Model Number	Radius of Ball Nose R	Effective Length ℓ_1	Length of Cut ℓ	Neck Diameter $\varnothing d_1$	Shank Taper Angle Bta	Overall Length L	Shank Diameter $\varnothing d$	Suggested Retail Price ¥	Effective Length by Inclined Angles				
									30′	1°	1°30′	2°	3°
DLCLB 2015-040	**R0.75**	4	1.2	1.47	11°	45	4	5,900	4.21	4.39	4.58	4.80	5.31
DLCLB 2015-060		6				45	4	5,900	6.31	6.59	6.89	7.23	8.04
DLCLB 2015-120		12				50	4	6,700	12.59	13.18	13.83	14.55	16.26
DLCLB 2015-180		18				55	4	7,400	18.87	19.77	20.76	21.86	24.47
DLCLB 2020-040	**R1**	4	1.6	1.98	11°	45	4	6,100	4.18	4.34	4.51	4.71	5.18
DLCLB 2020-060		6				45	4	6,100	6.27	6.53	6.82	7.15	7.92
DLCLB 2020-080		8				45	4	6,200	8.36	8.73	9.14	9.59	10.66
DLCLB 2020-100		10				45	4	6,200	10.46	10.93	11.45	12.02	13.39
DLCLB 2020-120		12				50	4	6,200	12.55	13.12	13.76	14.46	16.13
DLCLB 2020-140		14				50	4	6,200	14.65	15.32	16.07	16.90	18.87
DLCLB 2020-160		16				50	4	6,200	16.74	17.52	18.38	19.34	No Interference
DLCLB 2020-200		20				55	4	6,900	20.93	21.91	23.00	24.21	No Interference
DLCLB 2020-250		25				65	4	7,700	26.16	27.41	28.78	No Interference	No Interference
DLCLB 2030-100	**R1.5**	10	2.4	2.95	11°	60	6	7,900	10.51	10.96	11.46	12.01	13.32
DLCLB 2030-120		12				60	6	8,100	12.61	13.16	13.77	14.45	16.06
DLCLB 2030-140		14				60	6	8,100	14.70	15.36	16.08	16.89	18.80
DLCLB 2030-160		16				60	6	8,400	16.80	17.56	18.39	19.32	21.54
DLCLB 2030-200		20				70	6	8,400	20.98	21.95	23.02	24.20	27.01
DLCLB 2030-250		25				70	6	8,400	26.22	27.44	28.79	30.30	No Interference
DLCLB 2030-300		30				70	6	9,200	31.45	32.94	34.57	36.39	No Interference
DLCLB 2040-100	**R2**	10	3.2	3.95	11°	70	6	7,300	10.49	10.91	11.38	11.90	13.14
DLCLB 2040-150		15				70	6	7,300	15.73	16.41	17.16	18.00	19.99
DLCLB 2040-200		20				70	6	8,600	20.96	21.90	22.94	24.09	No Interference
DLCLB 2040-250		25				70	6	9,200	26.20	27.39	28.72	30.19	No Interference
DLCLB 2040-300		30				70	6	9,500	31.43	32.89	34.50	No Interference	No Interference
DLCLB 2040-400		40				80	6	10,300	41.90	43.87	No Interference	No Interference	No Interference
DLCLB 2060-100	**R3**	10	4.8	5.95	—	80	6	9,500	No Interference	No Interference	No Interference	No Interference	No Interference
DLCLB 2060-150		15				80	6	9,500	No Interference	No Interference	No Interference	No Interference	No Interference
DLCLB 2060-200		20				80	6	9,500	No Interference	No Interference	No Interference	No Interference	No Interference
DLCLB 2060-300		30				80	6	10,000	No Interference	No Interference	No Interference	No Interference	No Interference

DLCLB Milling Conditions

WORK MATERIAL			COPPER/ALUMINUM ALLOYS				TUNGSTEN COPPER			
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)
2001-003	**R0.05**	0.3	43,600	220	0.01	0.01	32,700	160	0.008	0.008
2001-005		0.5	43,600	160	0.007	0.007	32,700	110	0.005	0.005
20015-003	**R0.075**	0.3	43,600	250	0.015	0.02	32,700	190	0.012	0.016
20015-005		0.5	43,600	220	0.015	0.02	32,700	150	0.012	0.016
20015-010		1	43,600	160	0.007	0.01	32,700	120	0.006	0.008
2002-003	**R0.1**	0.3	43,600	550	0.025	0.05	32,700	380	0.02	0.04
2002-005		0.5	43,600	550	0.025	0.05	32,700	380	0.02	0.04
2002-010		1	43,600	440	0.02	0.04	32,700	270	0.015	0.03
2002-015		1.5	32,900	250	0.015	0.03	24,700	120	0.008	0.02
2003-006	**R0.15**	0.6	43,600	760	0.03	0.07	32,700	550	0.03	0.07
2003-010		1	43,600	760	0.03	0.07	32,700	550	0.03	0.07
2003-015		1.5	43,600	550	0.025	0.05	32,700	290	0.02	0.05
2003-020		2	39,200	390	0.02	0.03	29,400	200	0.01	0.02
2004-010	**R0.2**	1	43,600	1,090	0.05	0.1	32,700	760	0.04	0.08
2004-020		2	43,600	650	0.035	0.06	32,700	380	0.02	0.05
2004-030		3	35,000	470	0.02	0.04	29,200	230	0.01	0.03
2004-040		4	27,300	270	0.008	0.015	19,600	110	0.005	0.01
2005-010	**R0.25**	1	43,600	1,420	0.08	0.15	32,700	890	0.08	0.15
2005-020		2	43,600	870	0.08	0.15	32,700	550	0.08	0.15
2005-030		3	38,200	650	0.06	0.1	29,500	390	0.06	0.08
2005-040		4	32,700	440	0.04	0.08	24,000	220	0.025	0.05
2005-050		5	27,300	330	0.02	0.04	19,600	160	0.01	0.02
2006-010	**R0.3**	1	43,600	1,870	0.12	0.2	32,700	1,400	0.12	0.2
2006-020		2	43,600	1,750	0.12	0.2	32,700	1,310	0.12	0.2
2006-030		3	43,600	1,090	0.1	0.14	32,700	760	0.08	0.1
2006-040		4	32,700	760	0.07	0.1	27,300	440	0.04	0.06
2006-050		5	29,500	650	0.05	0.08	24,000	330	0.02	0.04
2006-060		6	27,300	550	0.04	0.06	21,800	220	0.01	0.03
2008-020	**R0.4**	2	43,600	2,820	0.15	0.3	32,700	1,980	0.15	0.3
2008-030		3	43,600	2,180	0.15	0.3	32,700	1,530	0.15	0.3
2008-040		4	38,200	1,750	0.12	0.2	29,500	1,090	0.1	0.16
2008-060		6	32,700	1,090	0.08	0.15	21,800	550	0.05	0.1
2008-080		8	23,800	760	0.05	0.06	17,300	320	0.02	0.025
2010-020	**R0.5**	2	39,100	2,740	0.25	0.4	30,000	2,050	0.25	0.4
2010-030		3	39,100	2,740	0.25	0.4	30,000	1,960	0.25	0.4
2010-040		4	39,100	2,350	0.2	0.4	29,500	1,560	0.2	0.4
2010-050		5	38,200	2,180	0.16	0.3	29,500	1,530	0.12	0.25
2010-060		6	34,500	1,840	0.14	0.3	26,200	1,150	0.1	0.25
2010-080		8	27,300	1,090	0.12	0.2	19,600	550	0.06	0.1
2010-100		10	20,300	810	0.08	0.15	16,200	300	0.03	0.05
2010-120		12	13,100	490	0.06	0.1	9,800	160	0.015	0.04
2015-040	**R0.75**	4	25,500	2,270	0.3	0.6	21,300	1,700	0.3	0.6
2015-060		6	25,500	2,040	0.3	0.6	21,300	1,530	0.3	0.6
2015-120		12	17,500	1,090	0.15	0.3	13,100	550	0.1	0.2
2015-180		18	8,500	590	0.08	0.12	6,800	170	0.02	0.06

DLCLB Milling Conditions

WORK MATERIAL			COPPER/ALUMINUM ALLOYS				TUNGSTEN COPPER			
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)
2020-040	**R1**	4	18,700	2,490	0.45	0.8	14,000	1,500	0.45	0.8
2020-060		6	18,700	2,080	0.45	0.8	14,000	1,250	0.45	0.8
2020-080		8	18,700	1,800	0.4	0.8	13,500	1,200	0.4	0.8
2020-100		10	18,700	1,700	0.3	0.6	13,500	1,190	0.25	0.5
2020-120		12	16,800	1,470	0.3	0.6	12,600	950	0.25	0.5
2020-140		14	15,000	1,250	0.28	0.5	11,200	750	0.18	0.4
2020-160		16	13,100	1,090	0.25	0.5	9,800	550	0.12	0.25
2020-200		20	10,000	800	0.15	0.3	8,000	350	0.06	0.1
2020-250		25	6,700	500	0.08	0.15	5,000	170	0.03	0.05
2030-100	**R1.5**	10	15,000	2,550	0.6	1.2	12,000	1,800	0.6	1.2
2030-120		12	15,000	2,550	0.6	1.2	11,800	1,740	0.6	1.2
2030-140		14	15,000	2,510	0.6	1.2	11,700	1,670	0.6	1.2
2030-160		16	14,200	2,140	0.6	1	10,700	1,600	0.5	1
2030-200		20	12,700	1,910	0.5	0.8	9,500	1,110	0.4	0.6
2030-250		25	10,100	1,520	0.4	0.6	8,400	760	0.2	0.3
2030-300		30	8,700	1,310	0.2	0.4	6,500	550	0.08	0.15
2040-100	**R2**	10	11,500	2,880	0.8	1.6	8,600	2,010	0.8	1.6
2040-150		15	11,500	2,670	0.8	1.6	8,600	1,880	0.8	1.6
2040-200		20	11,500	2,460	0.8	1.6	8,200	1,640	0.8	1.2
2040-250		25	10,300	2,210	0.6	1.2	6,700	1,270	0.5	1
2040-300		30	9,000	1,800	0.5	1	5,300	900	0.3	0.5
2040-400		40	6,000	900	0.4	0.8	3,800	380	0.15	0.3
2060-100	**R3**	10	10,000	4,190	1	2.2	7,500	3,150	1	2.2
2060-150		15	10,000	4,190	1	2.2	7,500	2,800	1	2.2
2060-200		20	10,000	3,000	1	2	7,500	2,000	0.7	1.5
2060-300		30	10,000	3,000	0.8	1.6	7,000	1,800	0.4	0.8



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

DLCLS NEW

DLCCOAT 2 Flute Long Neck Square End Mills for Copper Electrode Milling

ø0.1～ø3

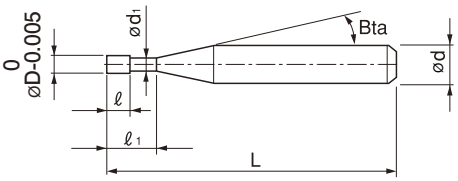
Super MG | DLC | 35° | Flatland | Shank Dia 0/-0.004

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

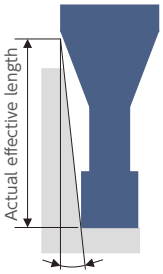
Work Material																
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS ～50 HRC	～55 HRC	～60 HRC	～65 HRC	～70 HRC	CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE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

Unit (mm)

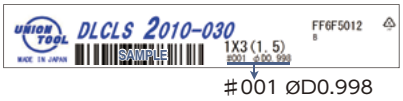
Outside Diameter	ø0.1～ø3
Diameter Tolerance	0/-0.005



The shank taper angle shown is not an exact value.



Label Sample

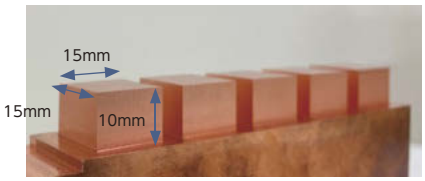


Diameter measurements are printed on the label to support High Precision milling.

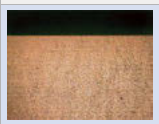
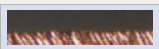
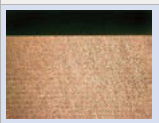
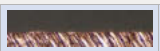
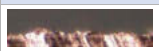
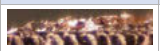
DLCLS Ø3 × EL12 • Ø1 × EL10

Copper Milling Example Comparison with conventional tool for Steels

C1100 Tough Pitch Copper



Coolant Oil Mist
Work Size 15 × 15 × h 10 mm

	1/5pcs (1 h 11min)		5/5pcs (4 h 47min)		
DLCLS Ø1 × EL10	 Ra 0.437 μm	 No burr	 Ra 0.465 μm	 0.015 mm Maximum burr height	 Minimum damage
Ø1 × EL10 Conventional tool	 Ra 0.809 μm	 0.027 mm Maximum burr height	 Ra 0.575 μm	 0.072 mm Maximum burr height	 Little wear

Process	Tool	Spindle Speed (min^{-1})	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Allowance (mm)	Cycle Time 5 work pieces (h:m:s)
Roughing	DLCLS Ø3 × EL12	16,000	2,400	3	0.15	0.08	0:21:44
Semi-finishing		16,000	2,400	0.4	0.02	0.03	1:44:10
Finishing	DLCLS Ø1 × EL10	19,200	540	0.2	0.01	0	4:47:32

Total 6:53:26

DLCLS reduces burrs compared to the conventional tool for Steels, improving milling surface and lengthens tool life.

DLCCOAT 2 Flute Long Neck Square End Mills for Copper Electrode Milling

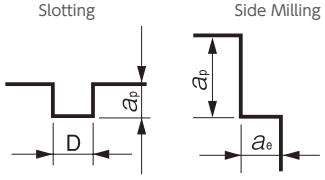
Total 35 models

Unit (mm)

Model Number	Outside Diamete ϕD	Effective Length ℓ1	Length of Cut ℓ	Neck Diameter ϕd1	Shank Taper Angle Bta	Overall Length L	Shank Diameter ϕd	Suggested Retail Price ¥	Effective Length by Inclined Angles				
									30′	1°	1°30′	2°	3°
DLCLS 2001-003	**0.1**	0.3	0.15	0.096	11°	45	4	10,500	0.30	0.30	0.32	0.34	0.39
DLCLS 2001-005		0.5				45	4	10,900	0.50	0.52	0.55	0.58	0.66
DLCLS 2002-005	**0.2**	0.5	0.3	0.19	11°	45	4	8,080	0.64	0.67	0.71	0.75	0.85
DLCLS 2002-010		1				45	4	8,500	1.16	1.22	1.29	1.36	1.54
DLCLS 2002-015		1.5				45	4	8,930	1.67	1.76	1.85	1.96	2.20
DLCLS 2003-010	**0.3**	1	0.45	0.29	11°	45	4	8,500	1.16	1.22	1.29	1.36	1.54
DLCLS 2003-015		1.5				45	4	8,930	1.67	1.76	1.85	1.96	2.20
DLCLS 2003-020		2				45	4	9,350	2.20	2.31	2.43	2.57	2.89
DLCLS 2004-010	**0.4**	1	0.6	0.39	11°	45	4	7,400	1.16	1.22	1.29	1.36	1.54
DLCLS 2004-020		2				45	4	7,570	2.20	2.31	2.43	2.57	2.89
DLCLS 2004-030		3				45	4	7,740	3.24	3.41	3.59	3.79	4.26
DLCLS 2005-020	**0.5**	2	0.75	0.49	11°	45	4	7,400	2.20	2.31	2.43	2.57	2.89
DLCLS 2005-030		3				45	4	7,570	3.24	3.41	3.59	3.79	4.26
DLCLS 2005-040		4				45	4	7,740	4.29	4.50	4.74	5.00	5.63
DLCLS 2005-060		6				45	4	7,990	6.38	6.70	7.05	7.44	8.37
DLCLS 2006-020	**0.6**	2	0.9	0.59	11°	45	4	5,880	2.20	2.31	2.43	2.57	2.89
DLCLS 2006-030		3				45	4	6,000	3.24	3.41	3.59	3.79	4.26
DLCLS 2006-040		4				45	4	6,130	4.29	4.50	4.74	5.00	5.63
DLCLS 2006-060		6				45	4	6,310	6.38	6.70	7.05	7.44	8.37
DLCLS 2008-030	**0.8**	3	1.2	0.79	11°	45	4	6,000	3.22	3.39	3.56	3.76	4.23
DLCLS 2008-040		4				45	4	6,130	4.27	4.48	4.72	4.98	5.60
DLCLS 2008-060		6				45	4	6,310	6.37	6.68	7.03	7.42	8.34
DLCLS 2010-030	**1**	3	1.5	0.98	11°	45	4	5,690	3.26	3.42	3.60	3.80	4.28
DLCLS 2010-040		4				45	4	5,750	4.31	4.52	4.76	5.02	5.65
DLCLS 2010-060		6				45	4	6,000	6.40	6.72	7.07	7.46	8.39
DLCLS 2010-080		8				45	4	6,130	8.49	8.92	9.38	9.90	11.13
DLCLS 2010-100		10				45	4	6,250	10.59	11.11	11.69	12.34	13.86
DLCLS 2015-060	**1.5**	6	2.25	1.47	11°	45	4	5,880	6.35	6.67	7.02	7.41	8.33
DLCLS 2015-100		10				45	4	6,200	10.54	11.06	11.64	12.28	13.80
DLCLS 2020-080	**2**	8	3	1.98	11°	50	4	6,160	8.42	8.84	9.30	9.81	11.03
DLCLS 2020-120		12				50	4	6,220	12.61	13.23	13.92	14.69	16.50
DLCLS 2020-160		16				50	4	6,360	16.80	17.63	18.55	19.56	No Interference
DLCLS 2030-120	**3**	12	4.5	2.96	11°	60	6	8,000	12.69	13.32	14.01	No Interference	No Interference
DLCLS 2030-160		16				60	6	8,330	16.88	17.71	18.64	No Interference	No Interference
DLCLS 2030-200		20				60	6	8,660	21.07	22.11	No Interference	No Interference	No Interference

DLCLS Milling Conditions

WORK MATERIAL			COPPER/ALUMINUM ALLOYS							TUNGSTEN COPPER						
			Side Milling				Slotting			Side Milling				Slotting		
Model Number	Outside Diameter (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)	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)
2001-003	0.1	0.3	40,000	200	0.1	0.005	40,000	100	0.01	36,000	180	0.05	0.005	36,000	90	0.01
2001-005		0.5	40,000	180	0.1	0.005	40,000	90	0.01	36,000	160	0.05	0.005	36,000	80	0.01
2002-005	0.2	0.5	40,000	400	0.2	0.01	40,000	200	0.02	36,000	360	0.1	0.01	36,000	180	0.02
2002-010		1	40,000	300	0.2	0.01	40,000	150	0.02	36,000	270	0.1	0.01	36,000	135	0.02
2002-015		1.5	32,000	200	0.2	0.008	32,000	100	0.02	28,800	180	0.1	0.008	28,800	90	0.02
2003-010	0.3	1	40,000	600	0.3	0.015	40,000	300	0.03	36,000	540	0.15	0.015	36,000	270	0.03
2003-015		1.5	40,000	590	0.3	0.015	40,000	295	0.03	36,000	530	0.15	0.015	36,000	265	0.03
2003-020		2	32,000	440	0.3	0.012	32,000	220	0.03	28,800	400	0.15	0.012	28,800	200	0.03
2004-010	0.4	1	40,000	800	0.4	0.02	40,000	400	0.04	36,000	720	0.2	0.02	36,000	360	0.04
2004-020		2	40,000	600	0.4	0.02	40,000	300	0.04	36,000	540	0.2	0.02	36,000	270	0.04
2004-030		3	32,000	400	0.4	0.016	32,000	200	0.04	28,800	360	0.2	0.016	28,800	180	0.04
2005-020	0.5	2	40,000	1,000	0.5	0.025	40,000	500	0.05	36,000	900	0.25	0.025	36,000	450	0.05
2005-030		3	32,000	750	0.5	0.02	32,000	375	0.05	28,800	680	0.25	0.02	28,800	340	0.05
2005-040		4	32,000	560	0.5	0.02	32,000	280	0.05	28,800	500	0.25	0.02	28,800	250	0.05
2005-060		6	25,600	380	0.5	0.015	25,600	190	0.05	23,000	340	0.25	0.015	23,000	170	0.05
2006-020	0.6	2	38,000	1,140	0.6	0.03	38,000	570	0.06	34,200	1,030	0.3	0.03	34,200	515	0.06
2006-030		3	38,000	1,000	0.6	0.03	38,000	500	0.06	34,200	900	0.3	0.03	34,200	450	0.06
2006-040		4	30,400	700	0.6	0.024	30,400	350	0.06	27,500	630	0.3	0.024	27,500	315	0.06
2006-060		6	30,400	560	0.6	0.024	30,400	280	0.06	27,500	500	0.3	0.024	27,500	250	0.06
2008-030	0.8	3	30,000	1,200	0.8	0.04	30,000	600	0.08	27,000	1,080	0.4	0.04	27,000	540	0.08
2008-040		4	30,000	1,000	0.8	0.04	30,000	500	0.08	27,000	900	0.4	0.04	27,000	450	0.08
2008-060		6	24,000	790	0.8	0.032	24,000	395	0.08	21,600	710	0.4	0.032	21,600	355	0.08
2010-030	1	3	24,000	1,200	1	0.05	24,000	600	0.1	21,600	1,080	0.5	0.05	21,600	540	0.1
2010-040		4	24,000	1,200	1	0.05	24,000	600	0.1	21,600	1,080	0.5	0.05	21,600	540	0.1
2010-060		6	19,200	900	1	0.04	19,200	450	0.1	17,300	810	0.5	0.04	17,300	405	0.1
2010-080		8	19,200	680	1	0.04	19,200	340	0.1	17,300	610	0.5	0.04	17,300	305	0.1
2010-100		10	19,200	540	1	0.04	19,200	270	0.1	17,300	490	0.5	0.04	17,300	245	0.1
2015-060	1.5	6	20,000	1,500	1.5	0.075	20,000	750	0.15	18,000	1,350	0.75	0.075	18,000	675	0.15
2015-100		10	16,000	900	1.5	0.06	16,000	450	0.15	14,400	810	0.75	0.06	14,400	405	0.15
2020-080	2	8	18,000	1,800	2	0.1	18,000	900	0.2	16,200	1,620	1	0.1	16,200	810	0.2
2020-120		12	14,400	1,350	2	0.08	14,400	675	0.2	13,000	1,220	1	0.08	13,000	610	0.2
2020-160		16	14,400	1,000	2	0.08	14,400	500	0.2	13,000	910	1	0.08	13,000	455	0.2
2030-120	3	12	16,000	2,400	3	0.15	16,000	1,200	0.3	14,400	2,160	1.5	0.15	14,400	1,080	0.3
2030-160		16	16,000	1,940	3	0.12	16,000	970	0.3	14,400	1,750	1.5	0.12	14,400	875	0.3
2030-200		20	12,800	1,450	3	0.12	12,800	725	0.3	11,500	1,310	1.5	0.12	11,500	655	0.3



D: Outside Diameter (mm)

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

DLCLRS NEW

DLCCOAT 2 Flute Long Neck Radius End Mills for Copper Electrode Milling

ø0.2~ø3

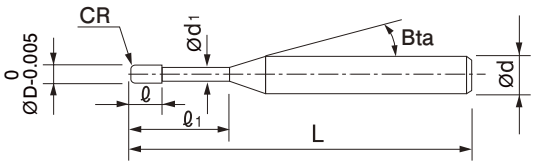
Super MG | DLC | 35° | R | R ±0.005 | Shank Dia 0/-0.004

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

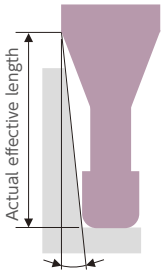
Work Material																
CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS ~50 HRC	~55 HRC	~60 HRC	~65 HRC	~70 HRC	CAST IRON	ALUMINUM ALLOYS	GRAPHITE	COPPER	PLASTICS	GLASS FILLED PLASTICS	TITANIUM ALLOYS	HEAT RESISTANT ALLOYS	CEMENTED CARBIDE	HARD BRITTLE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

Unit (mm)

Outside Diameter	ø0.2~ø3
Diameter Tolerance	0/-0.005
CR Tolerance	± 0.005



The shank taper angle shown is not an exact value.



Inclined angle

Label Sample

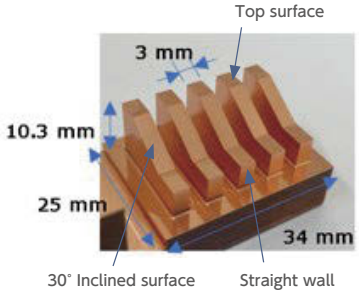
#001 ØD0.998 R+0.001/-0.001

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

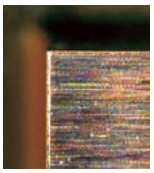
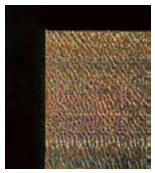
DLCLRS ø3 × CR0.5 × EL12

Copper Milling Example
Comparison with conventional tool for Steels

C1100
Tough Pitch Copper



Coolant: Oil mist

Top surface		30° Inclined surface		Straight wall	
DLCLRS	Conventional	DLCLRS	Conventional	DLCLRS	Conventional
					
Ra **0.014** μm	Ra **0.021** μm	Ra **0.103** μm	Ra **0.125** μm	Ra **0.109** μm	Ra **0.090** μm

DLCLRS:

Better surface roughness compared to the conventional tool. Less burrs and a clean edge.

Process	Spindle Speed (min^{-1})	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Allowance (mm)	Cycle Time 5 work pieces (h:m:s)
Roughing	14,000	2,940 Groove 1,470	0.3	1	0.08	0:16:29
Semi-finishing	14,000	2,940	0.05	0.05	0.03	0:45:48
Finishing	14,000	540	0.015	0.03	0	2:48:28

Total 3:50:45

DLCCOAT 2 Flute Long Neck Radius End Mills for Copper Electrode Milling

Total 48 models

Unit (mm)

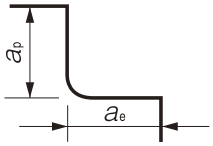
Model Number	Outside Diamete ØD	Corner Radius CR	Effective Length ℓ1	Length of Cut ℓ	Neck Diameter Ød1	Shank Taper Angle Bta	Overall Length L	Shank Diameter Ød	Suggested Retail Price ¥	Effective Length by Inclined Angles				
										30′	1°	1°30′	2°	3°
DLCLRS 2002-005-010	0.2	R0.05	1	0.2	0.19	11°	45	4	9,350	1.19	1.25	1.31	1.38	1.55
DLCLRS 2002-005-015			1.5				45	4	9,820	1.70	1.78	1.87	1.98	2.22
DLCLRS 2003-005-010	0.3	R0.05	1	0.3	0.29	11°	45	4	9,350	1.19	1.25	1.31	1.38	1.55
DLCLRS 2003-005-020			2				45	4	10,290	2.22	2.33	2.45	2.59	2.91
DLCLRS 2004-005-020	0.4	R0.05	2	0.4	0.39	11°	45	4	8,330	2.22	2.33	2.45	2.59	2.91
DLCLRS 2004-005-030			3				45	4	8,510	3.27	3.43	3.61	3.81	4.28
DLCLRS 2004-01-020		R0.1	2				45	4	8,330	2.22	2.33	2.44	2.58	2.89
DLCLRS 2004-01-030			3				45	4	8,510	3.27	3.42	3.60	3.80	4.26
DLCLRS 2005-005-020	0.5	R0.05	2	0.5	0.49	11°	45	4	8,140	2.22	2.33	2.45	2.59	2.91
DLCLRS 2005-005-030			3				45	4	8,330	3.27	3.43	3.61	3.81	4.28
DLCLRS 2005-005-040			4				45	4	8,510	4.31	4.53	4.76	5.02	5.64
DLCLRS 2005-01-020		R0.1	2				45	4	8,140	2.22	2.33	2.44	2.58	2.89
DLCLRS 2005-01-030			3				45	4	8,330	3.27	3.42	3.60	3.80	4.26
DLCLRS 2005-01-040			4				45	4	8,510	4.31	4.52	4.76	5.01	5.63
DLCLRS 2006-005-020	0.6	R0.05	2	0.6	0.59	11°	45	4	6,470	2.22	2.33	2.45	2.59	2.91
DLCLRS 2006-005-030			3				45	4	6,600	3.27	3.43	3.61	3.81	4.28
DLCLRS 2006-005-040			4				45	4	6,740	4.31	4.53	4.76	5.02	5.64
DLCLRS 2006-005-060			6				45	4	6,940	6.41	6.73	7.07	7.46	8.38
DLCLRS 2006-01-020		R0.1	2				45	4	6,470	2.22	2.33	2.44	2.58	2.89
DLCLRS 2006-01-030			3				45	4	6,600	3.27	3.42	3.60	3.80	4.26
DLCLRS 2006-01-040			4				45	4	6,740	4.31	4.52	4.76	5.01	5.63
DLCLRS 2006-01-060			6				45	4	6,940	6.41	6.72	7.07	7.45	8.36
DLCLRS 2008-005-040	0.8	R0.05	4	0.8	0.79	11°	45	4	6,740	4.30	4.51	4.74	5.00	5.62
DLCLRS 2008-005-060			6				45	4	6,940	6.39	6.71	7.05	7.44	8.36
DLCLRS 2008-01-040		R0.1	4				45	4	6,740	4.29	4.50	4.74	4.99	5.60
DLCLRS 2008-01-060			6				45	4	6,940	6.39	6.70	7.05	7.43	8.34
DLCLRS 2008-02-040		R0.2	4				45	4	6,740	4.29	4.49	4.72	4.97	5.57
DLCLRS 2008-02-060			6				45	4	6,940	6.38	6.69	7.03	7.41	8.30
DLCLRS 2010-01-020	1	R0.1	2	1	0.98	11°	45	4	6,100	2.26	2.37	2.49	2.63	2.94
DLCLRS 2010-01-040			4				45	4	6,330	4.36	4.57	4.80	5.06	5.68
DLCLRS 2010-01-060			6				45	4	6,600	6.45	6.77	7.11	7.50	8.42
DLCLRS 2010-02-020		R0.2	2				45	4	6,100	2.26	2.36	2.48	2.60	2.91
DLCLRS 2010-02-040			4				45	4	6,330	4.35	4.56	4.79	5.04	5.65
DLCLRS 2010-02-060			6				45	4	6,600	6.45	6.76	7.10	7.48	8.39
DLCLRS 2015-02-060	1.5	R0.2	6	1.5	1.47	11°	45	4	6,470	6.40	6.71	7.05	7.43	8.32
DLCLRS 2015-02-100			10				45	4	6,700	10.59	11.10	11.67	12.30	13.80
DLCLRS 2020-01-080	2	R0.1	8	2	1.98	11°	50	4	6,780	8.47	8.89	9.34	9.85	11.06
DLCLRS 2020-01-120			12				50	4	6,840	12.66	13.28	13.97	14.73	16.54
DLCLRS 2020-01-160			16				50	4	6,940	16.85	17.67	18.59	19.61	No Interference
DLCLRS 2020-02-080		R0.2	8				50	4	6,780	8.47	8.88	9.33	9.83	11.03
DLCLRS 2020-02-120			12				50	4	6,840	12.65	13.27	13.95	14.71	16.50
DLCLRS 2020-02-160			16				50	4	6,940	16.84	17.67	18.57	19.58	No Interference
DLCLRS 2030-02-120	3	R0.2	12	3	2.96	11°	60	6	8,600	12.73	13.36	14.04	14.80	No Interference
DLCLRS 2030-02-200			20				60	6	8,980	21.11	22.14	No Interference	No Interference	No Interference
DLCLRS 2030-03-120		R0.3	12				60	6	8,600	12.73	13.35	14.03	14.78	No Interference
DLCLRS 2030-03-200			20				60	6	8,980	21.11	22.13	No Interference	No Interference	No Interference
DLCLRS 2030-05-120		R0.5	12				60	6	8,600	12.72	13.33	14.00	14.74	No Interference
DLCLRS 2030-05-200			20				60	6	8,980	21.10	22.12	No Interference	No Interference	No Interference

DLCLRS Milling Conditions

WORK MATERIAL				COPPER/ALUMINUM ALLOYS				TUNGSTEN COPPER			
Model Number	Outside Diameter (mm)	Corner Radius (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)
2002-005-010	**0.2**	**R0.05**	1	40,000	300	0.015	0.1	36,000	270	0.014	0.09
2002-005-015			1.5	32,000	150	0.01	0.1	28,800	140	0.009	0.09
2003-005-010	**0.3**	**R0.05**	1	40,000	600	0.03	0.15	36,000	540	0.027	0.14
2003-005-020			2	32,000	450	0.015	0.15	28,800	410	0.014	0.14
2004-005-020	**0.4**	**R0.05**	2	40,000	600	0.015	0.2	36,000	540	0.014	0.18
2004-005-030			3	32,000	400	0.01	0.2	28,800	360	0.009	0.18
2004-01-020		**R0.1**	2	40,000	600	0.03	0.2	36,000	540	0.027	0.18
2004-01-030			3	32,000	400	0.02	0.2	28,800	360	0.018	0.18
2005-005-020	**0.5**	**R0.05**	2	40,000	1,000	0.03	0.25	36,000	900	0.027	0.23
2005-005-030			3	32,000	1,000	0.02	0.25	28,800	900	0.018	0.23
2005-005-040			4	32,000	750	0.015	0.25	28,800	680	0.014	0.23
2005-01-020		**R0.1**	2	40,000	1,000	0.06	0.25	36,000	900	0.054	0.23
2005-01-030			3	32,000	1,000	0.04	0.25	28,800	900	0.036	0.23
2005-01-040			4	32,000	750	0.03	0.25	28,800	680	0.027	0.23
2006-005-020	**0.6**	**R0.05**	2	36,000	1,080	0.03	0.3	32,400	970	0.027	0.27
2006-005-030			3	36,000	1,080	0.03	0.3	32,400	970	0.027	0.27
2006-005-040			4	28,800	810	0.015	0.3	25,900	730	0.014	0.27
2006-005-060			6	28,800	540	0.01	0.3	25,900	490	0.009	0.27
2006-01-020		**R0.1**	2	36,000	1,080	0.06	0.3	32,400	970	0.054	0.27
2006-01-030			3	36,000	1,080	0.06	0.3	32,400	970	0.054	0.27
2006-01-040			4	28,800	810	0.03	0.3	28,800	730	0.027	0.27
2006-01-060			6	28,800	540	0.02	0.3	25,920	490	0.018	0.27
2008-005-040	**0.8**	**R0.05**	4	30,000	1,440	0.03	0.4	27,000	1,300	0.027	0.36
2008-005-060			6	24,000	1,440	0.02	0.4	21,600	1,300	0.018	0.36
2008-01-040		**R0.1**	4	30,000	1,440	0.06	0.4	27,000	1,300	0.054	0.36
2008-01-060			6	24,000	1,440	0.04	0.4	21,600	1,300	0.036	0.36
2008-02-040		**R0.2**	4	30,000	1,440	0.12	0.4	27,000	1,300	0.108	0.36
2008-02-060			6	24,000	1,440	0.08	0.4	21,600	1,300	0.072	0.36
2010-01-020	**1**	**R0.1**	2	25,000	1,500	0.06	0.5	22,500	1,350	0.054	0.45
2010-01-040			4	25,000	1,500	0.045	0.5	22,500	1,350	0.041	0.45
2010-01-060			6	20,000	1,120	0.03	0.5	18,000	1,010	0.027	0.45
2010-02-020		**R0.2**	2	25,000	1,500	0.12	0.5	22,500	1,350	0.108	0.45
2010-02-040			4	25,000	1,500	0.09	0.5	22,500	1,350	0.081	0.45
2010-02-060			6	20,000	1,120	0.06	0.5	18,000	1,010	0.054	0.45
2015-02-060	**1.5**	**R0.2**	6	20,000	1,800	0.12	0.75	18,000	1,620	0.108	0.68
2015-02-100			10	16,000	1,350	0.06	0.75	14,400	1,220	0.054	0.68

DLCLRS Milling Conditions

WORK MATERIAL				COPPER/ALUMINUM ALLOYS				TUNGSTEN COPPER			
Model Number	Outside Diameter (mm)	Corner Radius (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)
2020-01-080	2	R0.1	8	16,000	2,100	0.038	1	14,400	1,890	0.034	0.9
2020-01-120			12	12,800	1,400	0.025	1	11,500	1,260	0.023	0.9
2020-01-160			16	12,800	1,120	0.02	1	11,500	1,010	0.018	0.9
2020-02-080		R0.2	8	16,000	2,100	0.075	1	14,400	1,890	0.068	0.9
2020-02-120			12	12,800	1,400	0.05	1	11,500	1,260	0.045	0.9
2020-02-160			16	12,800	1,120	0.04	1	11,500	1,010	0.036	0.9
2030-02-120	3	R0.2	12	14,000	2,940	0.12	1.5	12,600	2,650	0.108	1.35
2030-02-200			20	11,200	2,940	0.072	1.5	10,100	2,650	0.065	1.35
2030-03-120		R0.3	12	14,000	2,940	0.18	1.5	12,600	2,650	0.162	1.35
2030-03-200			20	11,200	2,940	0.108	1.5	10,100	2,650	0.097	1.35
2030-05-120		R0.5	12	14,000	2,940	0.3	1.5	12,600	2,650	0.27	1.35
2030-05-200			20	11,200	2,940	0.18	1.5	10,100	2,650	0.162	1.35



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

Advisory for Safe Use of End Mills

Correct application and operation is strongly advised to avoid clogging, abrasion, etc, that could cause serious accidents or injuries.
Ignition or sparks generated during milling could lead to fire or extreme damage to the work piece.
End Mills are made with very sharp cutting edges and must be handled with extra care.

- Never touch the cutting edge with your bare hands, as this could cause serious injury. Special caution is required when opening the package.
- Dropping the tool could cause breakage or flying debris, leading to serious injury.
- During milling, unexpected impact or shock on the tool could cause breakage or flying debris. Ensure to use protective items such as safety glasses and a face guard.
- For best results, fine parameter adjustment may be required, depending on the materials; milling shape and strategy; machine rigidity and spindle capability.
- Use a machine that has high rigidity and generates a low level of vibration. Recommend setting the runout control value at 5μm or below for the small diameter tools ϕ1 or below.
- Do not use flammable cutting oils.

Advisory for Regrinding End Mills

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

U.S. UNION TOOL, INC.
(U.S. HEADQUARTERS)
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NORTHERN CALIFORNIA REGIONAL SERVICE CENTER
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1805 Little Orchard Street, Suite 120, San Jose, CA 95125 U.S.A.
Tel: 1-408-982-0205 Fax: 1-408-982-0320
UPPER MIDWEST REGIONAL SERVICE CENTER
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Samutprakarn 10570 THAILAND
Tel: 66-2-130-0908 Fax: 66-2-130-0909

UNION TOOL

https://www.uniontool.co.jp

0120-60-2620

Price & Specifications are subject to change without notice.

202304 DLCseries1 A