V series
Ø 3mm Shank End Mills
For Copper Electrode / Aluminum Milling

VDLC-AZS NEW
VDLCLS NEW

DLCCOAT
2 Flutes / 3 Flutes Long Neck Square

VDLCLB

DLCCOAT
2 Flutes Long Neck Ball

Opening the future of small diameter milling with Ø3mm shank tools.
Our reduced shank diameter contributes to conserving the limited resources of cemented carbide.

UNION TOOL CO.

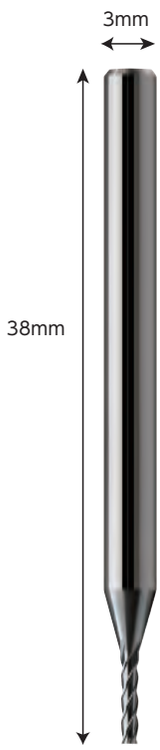
Recommended for improved milling quality and cost reduction!

New Ø3mm shank

V series
Union Tool's new standard

Ø3mm Shank（h4 tolerance）× Overall length 38mm

Fixed size of Ø3mm Shank x Overall Length 38mm
Ø3mm shank is used to save valuable carbide material. h4 tolerance is compatible for both shrink fit and collet holders.
More series to follow in the future.



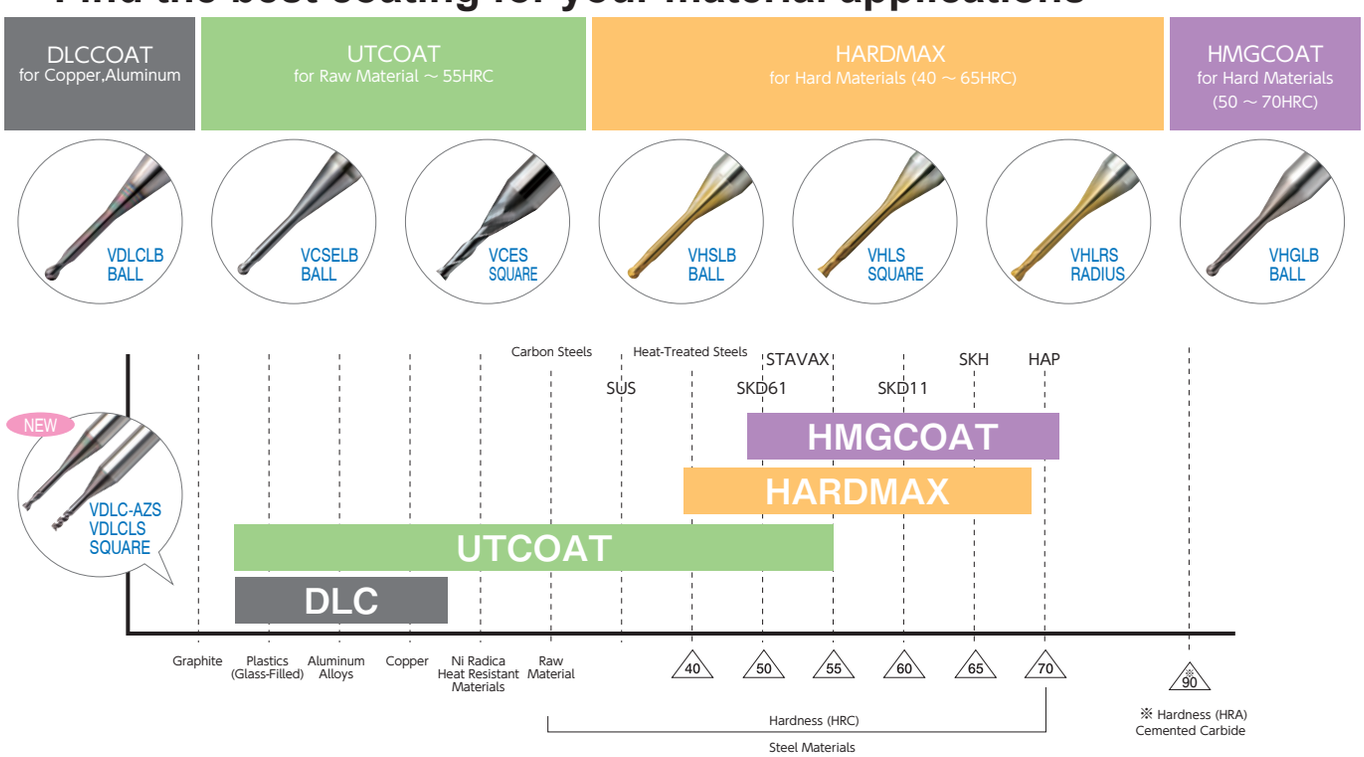
Cost effective

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

High Quality

Small diameter V series are high-precision as a result of using the latest in-house technologies.
We developed new grinding machines specialized for small diameter end mills for high-precision milling that will innovate manufacturing technology for high-precision, high-efficiency milling.

Find the best coating for your material applications



VDLC-AZS

V Series DLCCOAT Long Neck Square

3 Flute Short Shank Long Neck Square End Mills

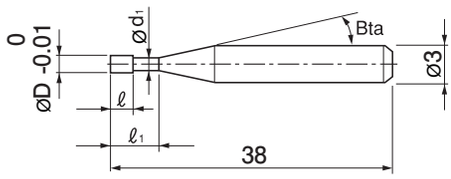
Super MG

DLC

45°

Shank Dia. 0/-0.003

Flatland



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

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

CARBON STEELS S45C S55C	ALLOY STEELS SK / SCM SUS	PREHARDENED STEELS NAK HPM	HARDENED STEELS ~ 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
									★		○	○					

Total 7 models

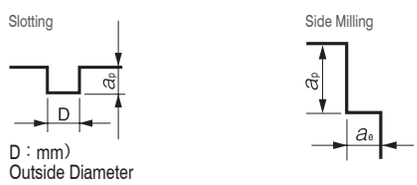
Unit (mm)

Model Number	Outside Diameter ØD	Effective Length ℓ1	Length of Cut ℓ	Neck Diameter Ød 1	Shank Taper Angle Bta	Series
VDLC-AZS 3010-030	**1**	3	2	0.97	16°	VDLC-AZS
VDLC-AZS 3010-050	**1**	5	2	0.97	16°	VDLC-AZS
VDLC-AZS 3015-045	**1.5**	4.5	3	1.45	16°	VDLC-AZS
VDLC-AZS 3020-060	**2**	6	4	1.95	16°	VDLC-AZS
VDLC-AZS 3020-100	**2**	10	4	1.95	16°	VDLC-AZS
VDLC-AZS 3025-075	**2.5**	7.5	5	2.42	16°	VDLC-AZS
VDLC-AZS 3030-090	**3**	9	6	2.92	—	VDLC-AZS

Milling Condition for VDLC-AZS

WORK MATERIAL			A5052							
Model Number	Outside Diameter (mm)	Effective Length (mm)	Spindle Speed (min^{-1})	Vertical		Slotting		Side Milling		
				Feed Rate (mm/min)	a_p Axial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)
3010-030	**1**	3	30,000	150	0.75	900	0.75	1,100	0.75	0.3
3010-050	**1**	5	22,500	100	0.75	600	0.75	800	0.75	0.3
3015-045	**1.5**	4.5	30,000	180	1.125	1,350	1.125	1,630	1.125	0.45
3020-060	**2**	6	30,000	225	1.5	1,800	1.5	2,150	1.5	0.6
3020-100	**2**	10	22,500	150	1.5	1,300	1.5	1,500	1.5	0.6
3025-075	**2.5**	7.5	25,000	225	1.875	1,900	1.875	2,300	1.875	0.75
3030-090	**3**	9	21,600	225	2.25	2,000	2.25	2,400	2.25	0.9
(mm)				a_p=0.75D		a_p=0.75D		a_p=0.75D a_e=0.3D		

WORK MATERIAL			A7075							
Model Number	Outside Diameter (mm)	Effective Length (mm)	Spindle Speed (min^{-1})	Vertical		Slotting		Side Milling		
				Feed Rate (mm/min)	a_p Axial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)
3010-030	**1**	3	30,000	150	0.75	540	0.75	860	0.75	0.3
3010-050	**1**	5	22,500	100	0.75	400	0.75	600	0.75	0.3
3015-045	**1.5**	4.5	30,000	180	1.125	820	1.125	1,230	1.125	0.45
3020-060	**2**	6	30,000	225	1.5	1,100	1.5	1,600	1.5	0.6
3020-100	**2**	10	22,500	150	1.5	800	1.5	1,100	1.5	0.6
3025-075	**2.5**	7.5	23,400	220	1.875	1,070	1.875	1,550	1.875	0.75
3030-090	**3**	9	20,200	225	2.25	1,100	2.25	1,600	2.25	0.9
(mm)				a_p=0.75D		a_p=0.75D		a_p=0.75D a_e=0.3D		



Note:
- Recommend using a non-contact measuring device to avoid damaging the sharp bottom corner.
- Decrease both spindle speed and feed rate proportionally in case of chattering.
- These milling parameters are calculated based on the shortest overhang length. Longer overhangs may require an adjustment to the milling parameters.
- Reduce the milling amount and feed rate in accordance with required milling precision.
- Spindle rigidity should be considered when setting milling parameters, especially for Z-Axis drilling.
- When slotting, using Z-Axis drilling, the milling parameters should promote good chip evacuation.
- Reduce the milling amount when chips clog on the tool during Z-Axis drilling.
- Set axial depth (ap) to 1/3 (ap=0.25D) in the area closest to a vertical wall with more than 2D work depth.
- These are milling parameters under the work material is firmly fixed. Decrease spindle speed and feed rate according to the condition.
- Recommend wet coolant.

VDLCLS

V Series DLCCOAT Long Neck Square

2 Flute Short Shank Long Neck Square End Mills

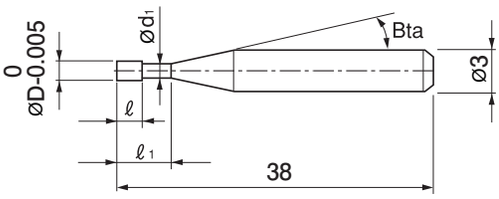
Super MG

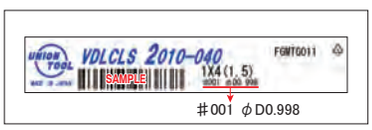
DLC

35°

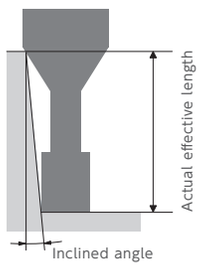
Shank Dia. 0/-0.003

Flatland





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



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Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

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									●		★						

Total 20 models

Unit (mm)

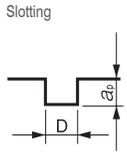
Model Number	Outside Diameter ØD	Effective Length ℓ1	Length of Cut ℓ	Neck Diameter Ød1	Shank Taper Angle Bta	Effective Length by Inclined Angles 30′	1°	1°30′	2°	3°	Series
VDLCLS 2002-005	**0.2**	0.5	0.3	0.18	11°	0.64	0.67	0.71	0.75	0.85	VDLCLS
VDLCLS 2002-010	**0.2**	1	0.3	0.18	11°	1.16	1.22	1.29	1.36	1.54	VDLCLS
VDLCLS 2003-010	**0.3**	1	0.45	0.28	11°	1.16	1.22	1.29	1.36	1.54	VDLCLS
VDLCLS 2003-015	**0.3**	1.5	0.45	0.28	11°	1.67	1.76	1.85	1.96	2.20	VDLCLS
VDLCLS 2004-010	**0.4**	1	0.6	0.38	11°	1.16	1.22	1.29	1.36	1.54	VDLCLS
VDLCLS 2004-020	**0.4**	2	0.6	0.38	11°	2.20	2.31	2.43	2.57	2.89	VDLCLS
VDLCLS 2004-030	**0.4**	3	0.6	0.38	11°	3.24	3.41	3.59	3.79	4.26	VDLCLS
VDLCLS 2005-020	**0.5**	2	0.75	0.48	11°	2.20	2.31	2.43	2.57	2.89	VDLCLS
VDLCLS 2005-030	**0.5**	3	0.75	0.48	11°	3.24	3.41	3.59	3.79	4.26	VDLCLS
VDLCLS 2005-040	**0.5**	4	0.75	0.48	11°	4.29	4.50	4.74	5.00	5.63	VDLCLS
VDLCLS 2006-020	**0.6**	2	0.9	0.58	11°	2.20	2.31	2.43	2.57	2.89	VDLCLS
VDLCLS 2006-030	**0.6**	3	0.9	0.58	11°	3.24	3.41	3.59	3.79	4.26	VDLCLS
VDLCLS 2006-040	**0.6**	4	0.9	0.58	11°	4.29	4.50	4.74	5.00	5.63	VDLCLS
VDLCLS 2008-040	**0.8**	4	1.2	0.79	11°	4.27	4.48	4.72	4.98	5.60	VDLCLS
VDLCLS 2008-060	**0.8**	6	1.2	0.79	11°	6.37	6.68	7.03	7.42	8.34	VDLCLS
VDLCLS 2010-040	**1**	4	1.5	0.98	11°	4.31	4.52	4.76	5.02	5.65	VDLCLS
VDLCLS 2010-060	**1**	6	1.5	0.98	11°	6.40	6.72	7.07	7.46	8.39	VDLCLS
VDLCLS 2010-080	**1**	8	1.5	0.98	11°	8.49	8.92	9.38	9.90	11.13	VDLCLS
VDLCLS 2015-060	**1.5**	6	2.25	1.46	11°	6.35	6.67	7.02	7.41	8.33	VDLCLS
VDLCLS 2020-080	**2**	8	3	1.97	11°	8.42	8.84	9.30	9.81	—	VDLCLS

Milling Condition for VDLCLS

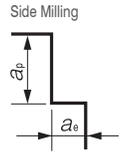
WORK MATERIAL			COPPER / ALUMINUM ALLOYS							TUNGSTEN COPPER						
			Side Milling				Slotting			Side Milling				Slotting		
Model Number	Outside Diameter (mm)	Effective Length (mm)	Spindle Speed (min^{-1})	Feed Rate (mm/min)	a_p Axial Depth (mm)	a_e Radial Depth (mm)	Spindle Speed (min^{-1})	Feed Rate (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)
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	**0.2**	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
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	**0.3**	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
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	**0.4**	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	**0.4**	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	**0.5**	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
2005-060	**0.5**	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	**0.6**	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	**0.6**	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
2008-040	**0.8**	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	**0.8**	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
2010-040	**1**	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	**1**	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	**1**	8	19,200	680	1	0.04	19,200	340	0.1	17,300	610	0.5	0.04	17,300	305	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
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

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.

Slotting



Side Milling



D : (mm)
Outside Diameter

Microchip shape milling example (A5052) Ø1mm

Comparison of VDLC-AZS (3 flute) with a 2 flute end mill for steel.

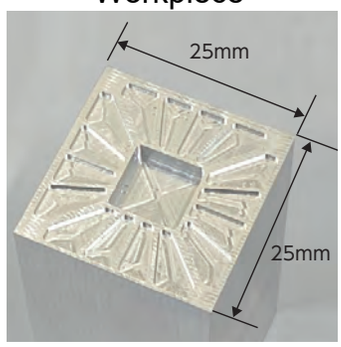
Condition

Coolant：Oil mist

Milling shape ：25 x 25 x depth 2.5 mm

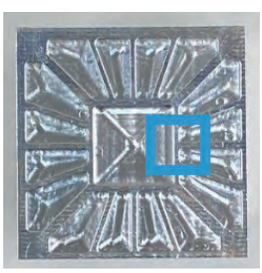
Process	n (min^{-1})	Vf (mm/min)	a_p (mm)	a_e (mm)	Allowance (mm)	Cycle time
Roughing	30,000	1,100	0.5	0.3	0.02	4 min. 33 sec.
Finishing	30,000	1,100	0.02	0.03	0	24 min.35 sec.
					Total	29 min. 8 sec.

Workpiece

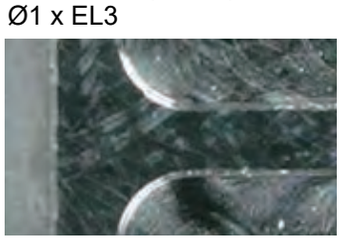


Work surface burr

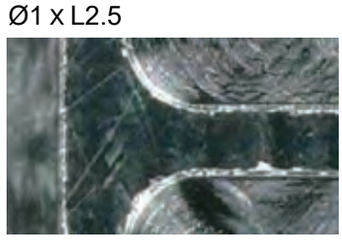
Comparison position for surface burr



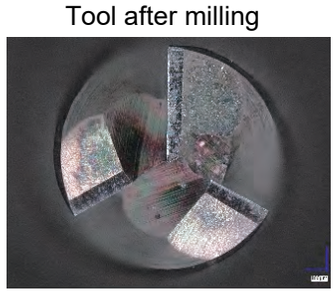
VDLC-AZS (3 flute)
Ø1 x EL3

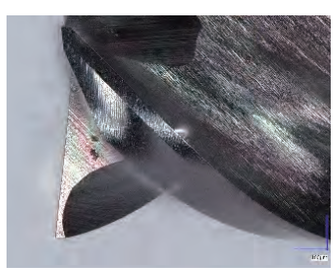


End mill for steel (2 flute)
Ø1 x L2.5



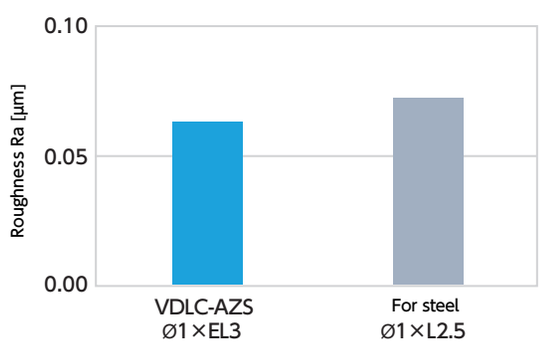
Tool after milling





Surface roughness

Measurement position for roughness

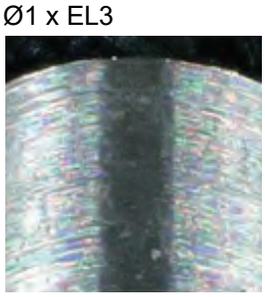


DLC Coating and the dedicated tool geometry for aluminum alloy offers the suppression of burrs and allows for a very smooth surface.

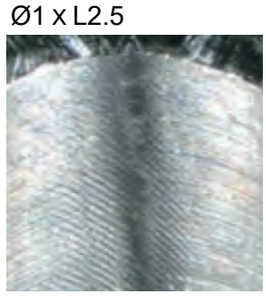
Surface at the corner

Comparison position for corner surface

VDLC-AZS (3 flute)
Ø1 x EL3



End mill for steel (2 flute)
Ø1 x L2.5



Small relief face are effective in suppressing chattering at the corners.

Microchip shape milling example (C1100) Ø1mm

Comparison of VDLCLS (2 flute) and the end mill for steel (2 flute)

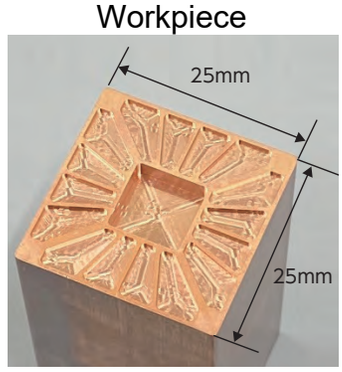
Condition

Coolant：Oil mist

Milling shape ：25 x 25 x depth 2.5 mm

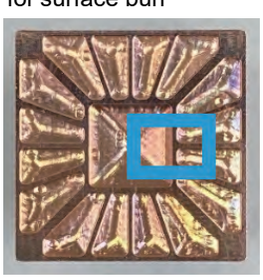
Process	n (min^{-1})	Vf (mm/min)	a_p (mm)	a_e (mm)	Allowance (mm)	Cycle time
Roughing	24,000	1,200	0.5	0.05	0.02	14 min. 8 sec.
Finishing	24,000	1,200	0.02	0.02	0	29 min.22 sec.
					Total	43 min. 30 sec.

Workpiece

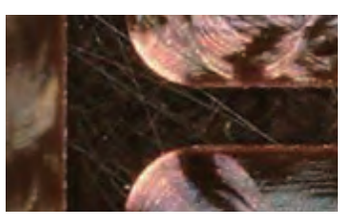


Work surface burr

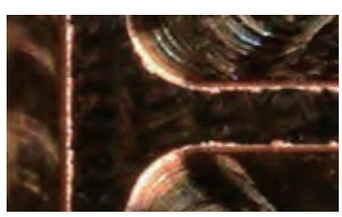
Comparison position for surface burr



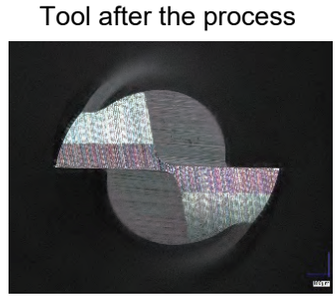
VDLCLS (2 flute)
Ø1 x EL4



End mill for steel (2 flute)
Ø1 x L2.5

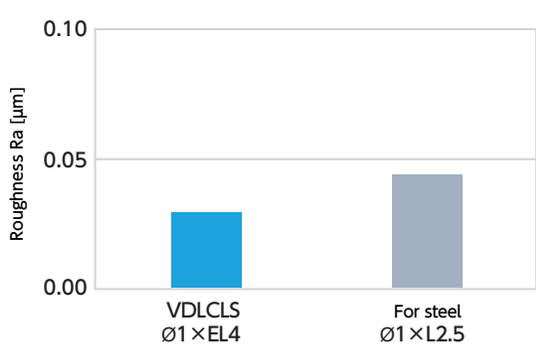


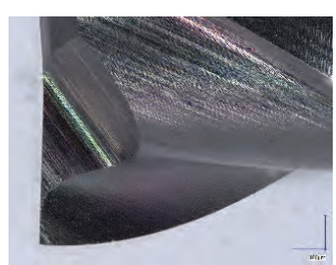
Tool after the process



Surface roughness

Measurement position for roughness





DLC Coating and the dedicated tool geometry for copper offers the suppression of burrs and allows for a very smooth surface.

VDLCLB

2 Flute Short Shank Long Neck Ball End Mills

V Series DLCCOAT Long Neck Ball

Super MG

DLC

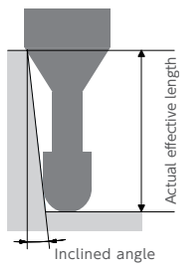
30°

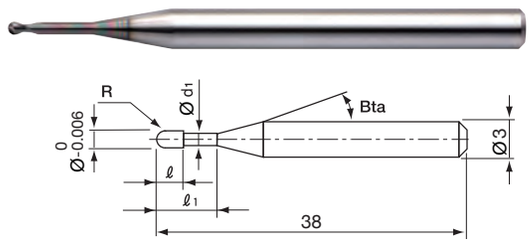
R ±0.002
R0.05~R0.2

R ±0.003
R0.25~R1

Shank Dia. 0/-0.003

Back Taper Geometry
Except for R0.05~R0.15





Label Sample

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

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

Material Applications (★ Highly Recommended ● Recommended ○ Suggested)

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

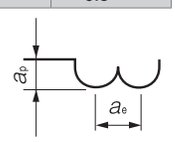
Total 32 models

Unit (mm)

Model Number	Radius of Ball Nose R	Effective Length ℓ1	Length of Cut ℓ	Neck Diameter Ød1	Shank Taper Bta	Effective Length by Inclined Angles 30′	1°	1°30′	2°	3°	Serie
VDLCLB 2001-003	R0.05	0.3	0.08	0.092	11°	0.35	0.37	0.39	0.41	0.46	VDLCLB
VDLCLB 2001-005	R0.05	0.5	0.08	0.092	11°	0.56	0.59	0.62	0.66	0.74	VDLCLB
VDLCLB 2002-005	R0.1	0.5	0.16	0.18	11°	0.64	0.67	0.70	0.74	0.83	VDLCLB
VDLCLB 2002-010	R0.1	1	0.16	0.18	11°	1.17	1.22	1.28	1.35	1.51	VDLCLB
VDLCLB 2002-015	R0.1	1.5	0.16	0.18	11°	1.68	1.77	1.86	1.95	2.19	VDLCLB
VDLCLB 2003-010	R0.15	1	0.24	0.28	11°	1.16	1.22	1.27	1.34	1.49	VDLCLB
VDLCLB 2003-020	R0.15	2	0.24	0.28	11°	2.21	2.31	2.43	2.55	2.86	VDLCLB
VDLCLB 2004-010	R0.2	1	0.32	0.38	11°	1.16	1.21	1.27	1.33	1.48	VDLCLB
VDLCLB 2004-020	R0.2	2	0.32	0.38	11°	2.20	2.31	2.42	2.54	2.84	VDLCLB
VDLCLB 2004-030	R0.2	3	0.32	0.38	11°	3.25	3.40	3.57	3.76	4.21	VDLCLB
VDLCLB 2004-040	R0.2	4	0.32	0.38	11°	4.30	4.50	4.73	4.98	5.58	VDLCLB
VDLCLB 2005-020	R0.25	2	0.4	0.48	11°	2.20	2.30	2.41	2.53	2.82	VDLCLB
VDLCLB 2005-030	R0.25	3	0.4	0.48	11°	3.25	3.40	3.57	3.75	4.19	VDLCLB
VDLCLB 2005-040	R0.25	4	0.4	0.48	11°	4.29	4.50	4.72	4.97	5.56	VDLCLB
VDLCLB 2006-020	R0.3	2	0.48	0.58	11°	2.20	2.30	2.40	2.52	2.80	VDLCLB
VDLCLB 2006-030	R0.3	3	0.48	0.58	11°	3.25	3.39	3.56	3.74	4.17	VDLCLB
VDLCLB 2006-040	R0.3	4	0.48	0.58	11°	4.29	4.49	4.71	4.96	5.54	VDLCLB
VDLCLB 2006-050	R0.3	5	0.48	0.58	11°	5.34	5.59	5.87	6.18	6.91	VDLCLB
VDLCLB 2006-060	R0.3	6	0.48	0.58	11°	6.39	6.69	7.03	7.40	8.28	VDLCLB
VDLCLB 2008-030	R0.4	3	0.64	0.78	11°	3.24	3.38	3.54	3.72	4.14	VDLCLB
VDLCLB 2008-040	R0.4	4	0.64	0.78	11°	4.29	4.48	4.70	4.94	5.51	VDLCLB
VDLCLB 2008-060	R0.4	6	0.64	0.78	11°	6.38	6.68	7.01	7.38	8.24	VDLCLB
VDLCLB 2010-020	R0.5	2	0.8	0.97	11°	2.22	2.31	2.41	2.52	2.77	VDLCLB
VDLCLB 2010-030	R0.5	3	0.8	0.97	11°	3.27	3.41	3.56	3.73	4.14	VDLCLB
VDLCLB 2010-040	R0.5	4	0.8	0.97	11°	4.32	4.51	4.72	4.95	5.51	VDLCLB
VDLCLB 2010-060	R0.5	6	0.8	0.97	11°	6.41	6.70	7.03	7.39	8.25	VDLCLB
VDLCLB 2010-080	R0.5	8	0.8	0.97	11°	8.50	8.90	9.34	9.83	10.99	VDLCLB
VDLCLB 2015-040	R0.75	4	1.2	1.45	11°	4.26	4.43	4.63	4.85	5.36	VDLCLB
VDLCLB 2015-060	R0.75	6	1.2	1.45	11°	6.35	6.63	6.94	7.28	8.10	VDLCLB
VDLCLB 2020-040	R1	4	1.6	1.95	11°	4.25	4.41	4.59	4.79	5.27	VDLCLB
VDLCLB 2020-060	R1	6	1.6	1.95	11°	6.34	6.61	6.90	7.23	8.01	VDLCLB
VDLCLB 2020-080	R1	8	1.6	1.95	11°	8.43	8.80	9.21	9.67	No Interference	VDLCLB

VDLCLB Milling Conditions

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



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

Milling Example of Copper Electrode Model (Tough Pitch Copper) C1100
R1 x Effective length 8mm
The comparison example of VDLCLB(Ø3 shank) and DLCLB(Ø4 shank)

Condition

Work material:Tough Pitch Copper C1100

Coolant: Oil mist

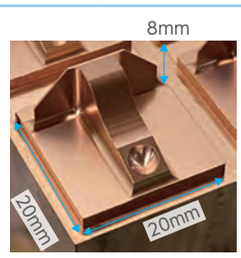
Milling shape ：20mm x 20mm x height 8 mm

Tool

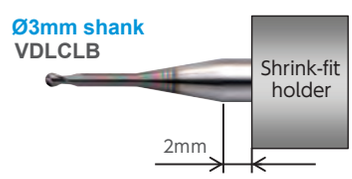
VDLCLB 2020-080 (Ø3mm shank)

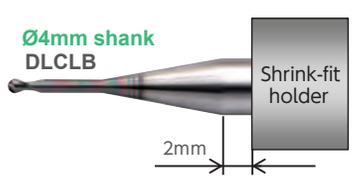
DLCLB 2020-080 (Ø4mm shank)

VDLCLB Milling Video



Milling shape





- 1 tool for roughing to semi-finishing, 1 tool for finishing. In total 2 tools.
- Both models are set so that the overhang of shank is 2mm.

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

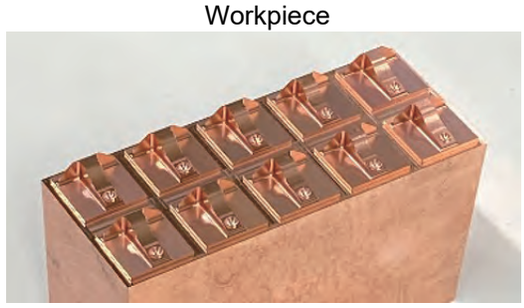
Comparison of work surface and tool wearing

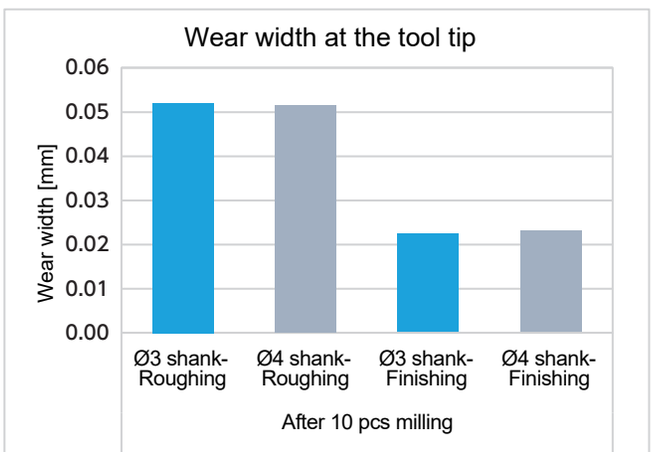
VDLCLB(Ø3mm shank)

Workpiece

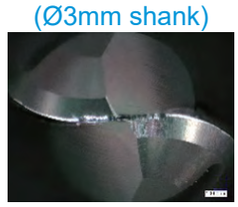
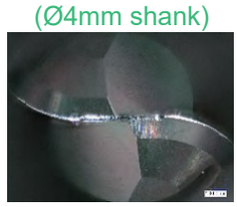
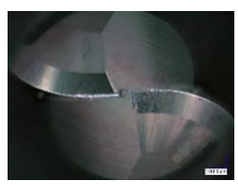
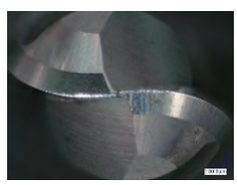
DLCLB(Ø4mm shank)

Workpiece





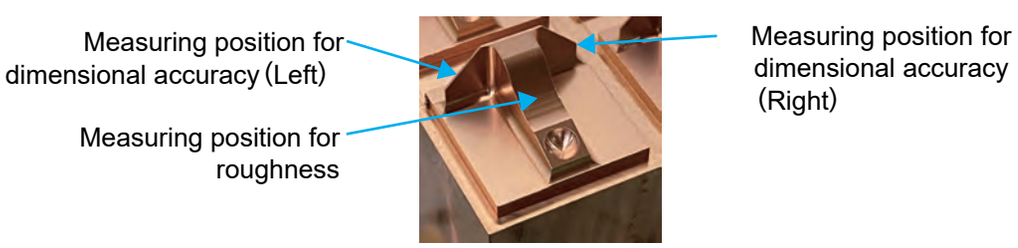
Tool after 10pcs milling

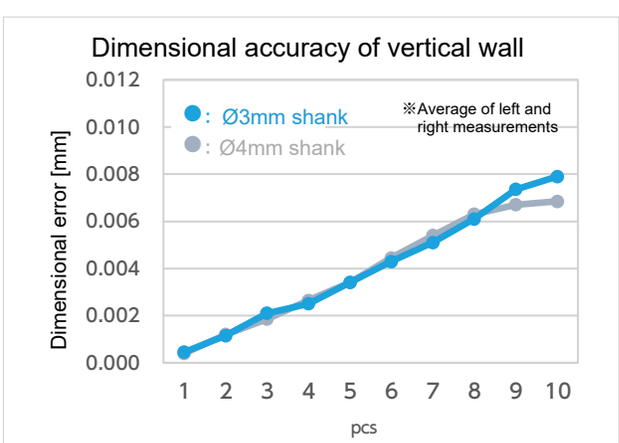
	VDLCLB (Ø3mm shank)	DLCLB (Ø4mm shank)
Roughing to Semi-finishing Cycle time: 15 h 15 min		
Finishing Cycle time: 12 h 50 min		

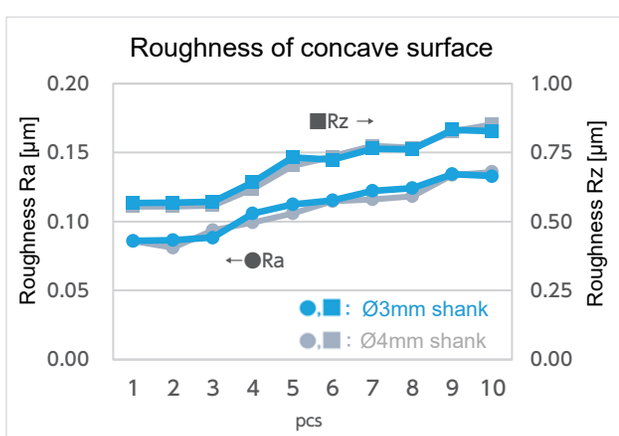
No difference of tool wearing with regard to the shank diameter gap.

Comparison of dimensional accuracy and roughness

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







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

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.

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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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https://www.uniontool.com

0120-60-2620

Price & Specifications are subject to change without notice.

202310 VDLC Series 10KA