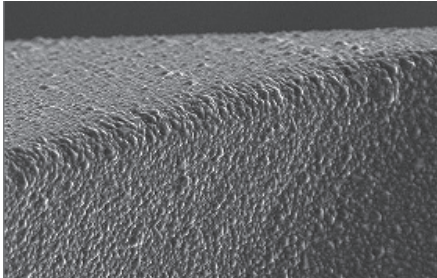




Features of Coating

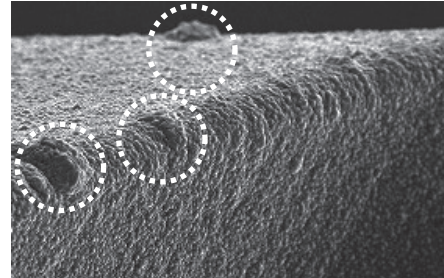
Smooth diamond coating achieved through advanced technology.

DG Coating



- Sharp cutting edge with minimal roundness
 → Low resistance to minimize the chipping of the workpiece
- Stable diamond crystals for milling graphite

Competitor's diamond coating



Irregular huge diamond grains exist on the cutting edge

Features of shape

Seamless shape improves contour milling quality.

No corner burrs



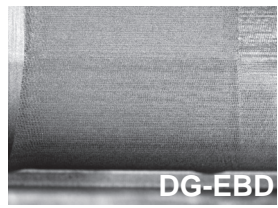
DG-EBD

Corner burrs

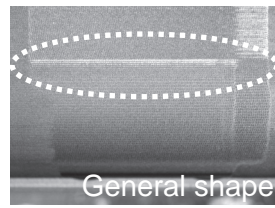


General shape

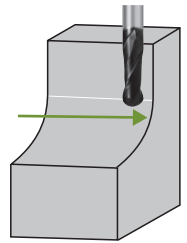
Without having an edge between the corner radius and the radial relief, it prevents steps on work surface and makes better finish.



DG-EBD



General shape



Condition of edge captured through projection photography (the portion connecting the radial edge with the ball edge)

Even with a small-diameter size that copies the shape of the edge, the beautiful cutting face and the smooth coating enable the end mill to draw a clean edge.

R1 x 2



DG Coating

R1 x 2






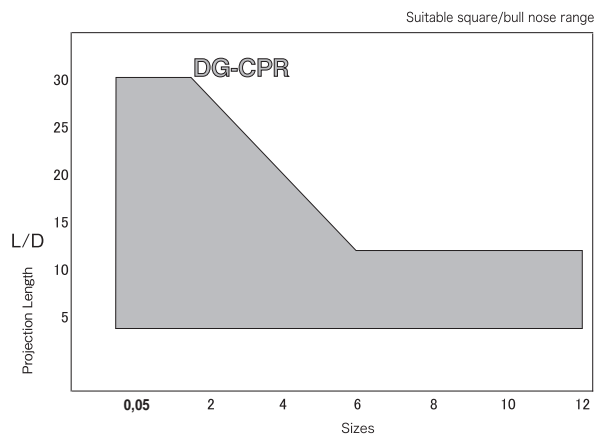
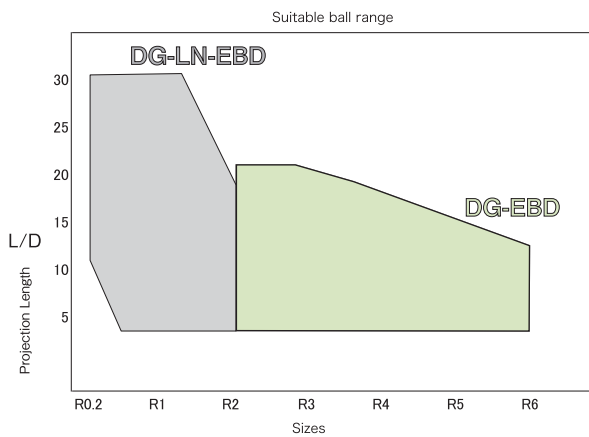
Competitor's diamond coating



Features of Coating

Smooth diamond coating achieved through advanced technology.

Types	Abbreviation	Stocked Sizes	Items	Applications
Ball	 DG-EBD	R2~R6	13	The cutting portion and the shank have the same shape, without creating interference. Therefore, the extension length can be adjusted freely.
	 DG-LN-EBD	R0,2~R2	33	An effective length that is ideal for the depth of cut can be selected, making highly efficient milling possible.
Bull Nose	 DG-CPR	ø0,5~ø12	37	An ideal radius shape has been adopted with the electrode discharge gaps in mind. Together with a high-precision radius shape, this is ideal for finishing shaped surfaces.



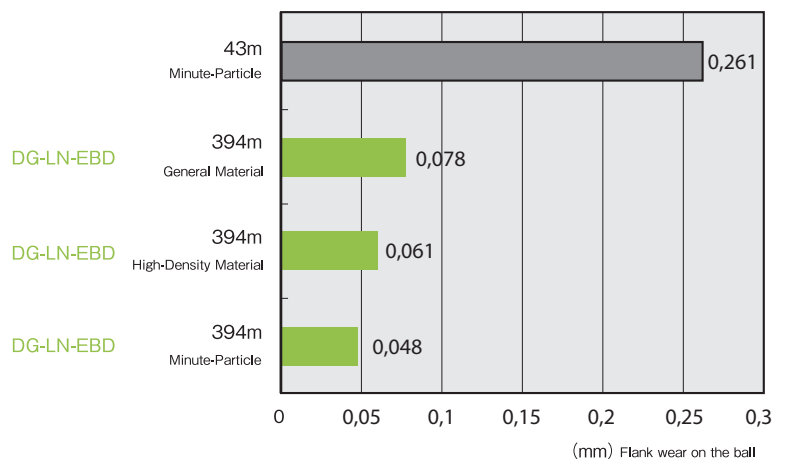
L/D stands for tool over hang length / tool dia.

Features of Coating

Smooth diamond coating achieved through advanced technology.

When using the DG Coated Ball End Mills, stable machining is possible even when machining small particle, high-density graphite. Compared with coated carbide end mills, a tremendous improvement in tool life has been made possible.

Tools	DG-LN-EBD
Size	R2x20
Work Material	Right description
Speed	10.000min-1
Feed	1.600mm/min
Milling Method	Straight line machining
Depth of Cut	ap=0,5mm pf=0,8mm
Coolant	Dry
Machine	BT40
Vertical Machining	Center
Tool life results	Wear after milling 394m





DG-EBD

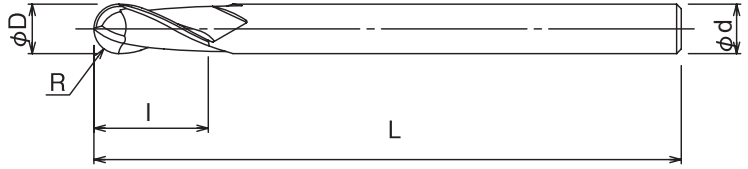
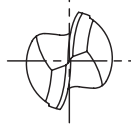


Tool Material : Carbide

Surface Treatment : DG Coating

Helix Angle : 30°

Tolerance of Ball Nose Radius : ± 0,01mm



(Unit : mm)

EDP No.	R x l x L	R	D	l	d	L	€
8553541	R2 x 8 x 80	2	4	8	4	80	
8553561	R3 x 12 x 80	3	6	12	6	80	
8553581	R4 x 16 x 100	4	8	16	8	100	
8553601	R5 x 20 x 100	5	10	20	10	100	
8553621	R6 x 36 x 130	6	12	36	12	130	



Work Material		Graphite											
		Roughing					Finishing						
		(min ⁻¹)		(mm/min)		(mm)		(min ⁻¹)		(mm/min)		(mm)	
RxL	(mm)	Short	Long	Short	Long	ap	Pf	Short	Long	Short	Long	ap	Pf
R2 x 8 x 80	16 ~ 40	20.000 ~ 11.000	3.150 ~ 1.800	0,4	1,2	20.000 ~ 11.000	2.100 ~ 1.200	0,12	0,12				
R3 x 12 x 80	24 ~ 36	20.000 ~ 9.600	4.500 ~ 2.100	0,6	1,8	20.000 ~ 9.600	3.000 ~ 1.400	0,18	0,18				
R4 x 16 x 100	32 ~ 56	16.000 ~ 7.200	3.900 ~ 1.800	0,8	2,4	16.000 ~ 7.200	2.600 ~ 1.200	0,22	0,22				
R5 x 20 x 100	40 ~ 60	12.500 ~ 5.700	3.000 ~ 1.350	1	3	12.500 ~ 5.700	2.000 ~ 900	0,26	0,26				
R6 x 36 x 130	48 ~ 84	10.500 ~ 4.800	2.550 ~ 1.100	1,2	3,6	10.500 ~ 4.800	1.700 ~ 750	0,3	0,3				

Set the diagonal plunge angle to be approximately 0,5° and 1°.

- Adjust the speed, the feed rate, and the depth of cut to suit your operating conditions, such as the milling shape, machine rigidity, tool holder rigidity, and work holding force.
- If you are unable to raise the speed and feed rate higher than those indicated in the table above, lower the speed and feed rate using the same ratio.
- If the workpiece gets chipped or if the operation requires a higher level of milling precision, lower the feed rate as necessary.
- Depending on the shape, if the workpiece chatters, lower the speed and feed rate using the same ratio.
- To mill graphite, use a dedicated milling machine. To prevent inhalation of dust, use a dust collector and a dust mask when working around graphite.
- During milling, keep the runout at the tip of the end mill to be less than 0.01 mm.
- To achieve efficient finishing, the feed rate may be adjusted as high as triple the rate.
- For high-efficiency machining, lower the feed rate as far down as 30% for high-load operations such as slotting. This can minimize the amount of cutting remnants resulting from the flexing of the tool.
- If gouging occurs while milling a flat area, raise the speed.
- If a cut involves the shaping of a corner, use the corner radius process of the program, or adjust the speed so that it would not cause chattering, and reduce the speed at the corner at the same time (by approximately 60%).



DG-CPR



Tool Material : Carbide

Surface Treatment : DG Coating

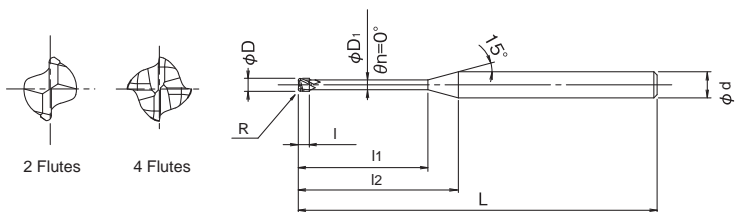
Helix Angle : 30°

Tolerance for Outer Diameter : LDLDaPP

LDⁿ aPP

Tolerance for Ball Nose Radius : ± 0,01 mm

Clearance for the effective length : LDLDOPP
LDLDOPP



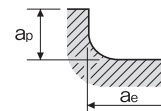
Dia. 4 < D

l1 + 0,5 mm

(Unit : mm)

EDP No.	D x r x n x l1	D	R	l1	l	D1	l2	Z	d	L	€
8554511	0,5 x R0,1 x 0° x 4	0,5	0,1	4	0,9	0,46	10,98	2	4	50	
8554512	0,5 x R0,1 x 0° x 6	0,5	0,1	6	0,9	0,46	12,98	2	4	50	
48103001	1 x R0,1 x 0° x 10	1,0	0,1	10	1,5	0,96	16,05	2	4	50	
8554542	2 x R0,2 x 0° x 10	2,0	0,2	10	3,0	1,90	14,35	2	4	60	
8554544	2 x R0,2 x 0° x 20	2,0	0,2	20	3,0	1,90	24,35	2	4	70	
48103002	4 x R0,3 x 0° x 40	4,0	0,3	40	6,0	3,90	-	4	6	100	
48103004	4 x R0,5 x 0° x 25	4,0	0,5	25	6,0	3,90	-	4	6	70	
48103003	4 x R0,5 x 0° x 40	4,0	0,5	40	6,0	3,90	-	4	6	100	
48103005	4 x R1,0 x 0° x 40	4,0	1,0	40	6,0	3,90	-	4	6	100	
48103006	6 x R0,3 x 0° x 30	6,0	0,3	30	6,0	5,70	-	4	6	100	
8554621	6 x R0,5 x 0° x 30	6,0	0,5	30	6,0	5,70	-	4	6	100	
8554622	6 x R1,0 x 0° x 30	6,0	1,0	30	6,0	5,70	-	4	6	100	
48103007	8 x R0,3 x 0° x 100	8,0	0,3	100	8,0	7,60	-	4	8	150	
8554661	8 x R0,5 x 0° x 30	8,0	0,5	30	8,0	7,60	-	4	8	100	
48103008	8 x R0,5 x 0° x 100	8,0	0,5	100	8,0	7,60	-	4	8	150	
48103009	8 x R1,0 x 0° x 100	8,0	1,0	100	8,0	7,60	-	4	8	150	
8554701	10 x R0,5 x 0° x 40	10,0	0,5	40	10,0	9,50	-	4	10	125	
8554702	10 x R1,0 x 0° x 40	10,0	1,0	40	10,0	9,50	-	4	10	125	
8554722	12 x R1,0 x 0° x 48	12,0	1,0	48	12,0	11,40	-	4	12	150	

DG-CPR / Recommended Milling Conditions

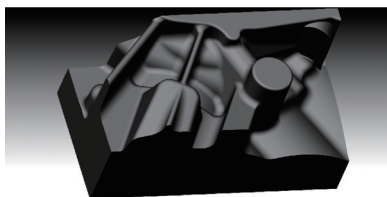


Work Material	Graphite											
	Roughing						Finishing					
	(min ⁻¹)		(mm/min)		(mm)		(min ⁻¹)		(mm/min)		(mm)	
Dc x r x n x lz	Short	Long	Short	Long	ap	ae	Short	Long	Short	Long	ap	ae
0,5 x R0,1 x 0° x 4	20.000	~ 16.000	720	~ 575	0,05	0,24	20.000	~ 16.000	600	~ 480	0,05	0,12
0,5 x R0,1 x 0° x 6	20.000	~ 16.000	720	~ 575	0,05	0,24	20.000	~ 16.000	600	~ 480	0,05	0,12
1 x R0,1 x 0° x 10	16.000	~ 12.000	1.150	~ 865	0,10	0,48	16.000	~ 12.000	960	~ 720	0,08	0,24
2 x R0,2 x 0° x 10	16.000	~ 12.000	2.050	~ 1.500	0,30	1,28	16.000	~ 12.000	1.450	~ 1.100	0,08	0,64
2 x R0,2 x 0° x 20	11.000	~ 8.000	1.400	~ 1.000	0,18	1,20	11.000	~ 8.000	990	~ 720	0,08	0,64
4 x R0,3 x 0° x 40	12.000	~ 8.000	3.450	~ 2.300	0,35	2,80	12.000	~ 8.000	2.450	~ 1.650	0,08	1,40
4 x R0,5 x 0° x 25	12.000	~ 8.000	2.950	~ 1.870	0,40	3,00	12.000	~ 8.000	2.180	~ 1.180	0,32	1,50
4 x R0,5 x 0° x 40	12.000	~ 8.000	3.450	~ 2.300	0,35	3,00	12.000	~ 8.000	2.410	~ 1.650	0,08	1,70
4 x R1 x 0° x 40	12.000	~ 8.000	3.450	~ 2.300	0,35	3,00	12.000	~ 8.000	2.410	~ 1.650	0,08	2,00
6 x R0,3 x 0° x 30	12.000	~ 8.000	3.450	~ 2.300	1,50	4,80	12.000	~ 8.000	2.410	~ 1.650	0,15	2,40
6 x R0,5 x 0° x 30	12.000	~ 7.000	4.300	~ 2.500	1,50	4,00	12.000	~ 7.000	3.050	~ 1.800	0,20	2,00
6 x R1 x 0° x 30	12.000	~ 7.000	4.300	~ 2.500	1,50	3,20	12.000	~ 7.000	3.050	~ 1.800	0,40	1,60
8 x R0,3 x 0° x 100	5.000	~ 3.500	2.000	~ 800	2,00	4,20	5.000	~ 3.500	1.500	~ 500	0,10	2,00
8 x R0,5 x 0° x 32	10.000	~ 7.000	3.800	~ 2.650	2,00	5,60	10.000	~ 7.000	2.700	~ 1.900	0,20	2,80
8 x R0,5 x 0° x 100	5.000	~ 3.500	2.000	~ 800	2,00	3,60	5.000	~ 3.500	1.500	~ 500	0,10	1,40
8 x R1 x 0° x 100	5.000	~ 3.500	2.000	~ 800	2,00	3,00	5.000	~ 3.500	1.500	~ 500	0,20	1,00
10 x R0,5 x 0° x 40	8.000	~ 4.000	3.050	~ 1.500	2,50	7,20	8.000	~ 4.000	2.200	~ 1.100	0,20	4,40
10 x R1 x 0° x 40	8.000	~ 4.000	3.050	~ 1.500	2,50	6,40	8.000	~ 4.000	2.200	~ 1.100	0,40	3,20
12 x R1 x 0° x 48	6.000	~ 3.000	2.300	~ 1.150	3,00	8,00	6.000	~ 3.000	1.650	~ 815	0,40	4,00

Set the diagonal plunge angle to be approximately 0,3° and 0,5°.

1. Adjust the speed, the feed rate, and the depth of cut to suit your operating conditions, such as the milling shape, machine rigidity, tool holder rigidity, and work holding force.
2. If you are unable to raise the speed and feed rate higher than those indicated in the table above, lower the speed and feed rate using the same ratio.
3. If the workpiece gets chipped or if the operation requires a higher level of milling precision, lower the feed rate as necessary.
4. Depending on the shape, if the workpiece chatters, lower the speed and feed rate using the same ratio.
5. To mill graphite, use a dedicated milling machine. To prevent inhalation of dust, use a dust collector and a dust mask when working around graphite.
6. During milling, keep the runout at the tip of the end mill to be less than 0.01 mm.
7. When making a rough cut with a ø4 end mill or greater, you can raise the feed rate as high as triple the rate, for making a Z cut depth that is less than the corner radius.
8. To achieve efficient finishing, the feed rate may be adjusted as high as triple the rate.
9. For high-efficiency machining, lower the feed rate as far down as 30% for high-load operations such as slotting. This can minimize the amount of cutting remnants resulting from the flexing of the tool.
10. When finishing a horizontal plane, lower the feed rate as far down as 40% on a milling machine that operates quietly.
11. When finishing a shape with a corner radius, change the milling pitch (corner radius x 0.06 = finishing pitch).
12. If a cut involves the shaping of a corner, use the corner radius process of the program, or adjust the speed so that it would not cause chattering, and reduce the speed at the corner at the same time (by approximately 60%).

Graphite machining using the DG Series



Data Provider

Process	Tool		Machining mode	Speed (min ⁻¹)	Feed (mm/min)			Cutting Time (min)
Roughing	F2039G	R10xSS20x130	Leveled contour roughing	6.000	2.500	5	5	32
Semi-Finishing	DG-EBD	R3x30x120	Corner contour machining	7.000	1.400	1	1	21
Finishing	DG-EBD	R5x50x150	Leveled contour finishing	6.000	1.500	0,35	0,35	132
Finishing	DG-EBD	R3x30x120	Corner contour machining	7.000	1.400	0,25	0,25	24
Finishing	DG-EBD	R2x20x120	Corner contour machining	7.000	1.000	0,2	0,2	33
Finishing	DG-LN-EBD	R1x60	Corner contour machining	6.200	600	0,15	0,15	7

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