

D Series Endmill



Diamond Coated Endmill Series

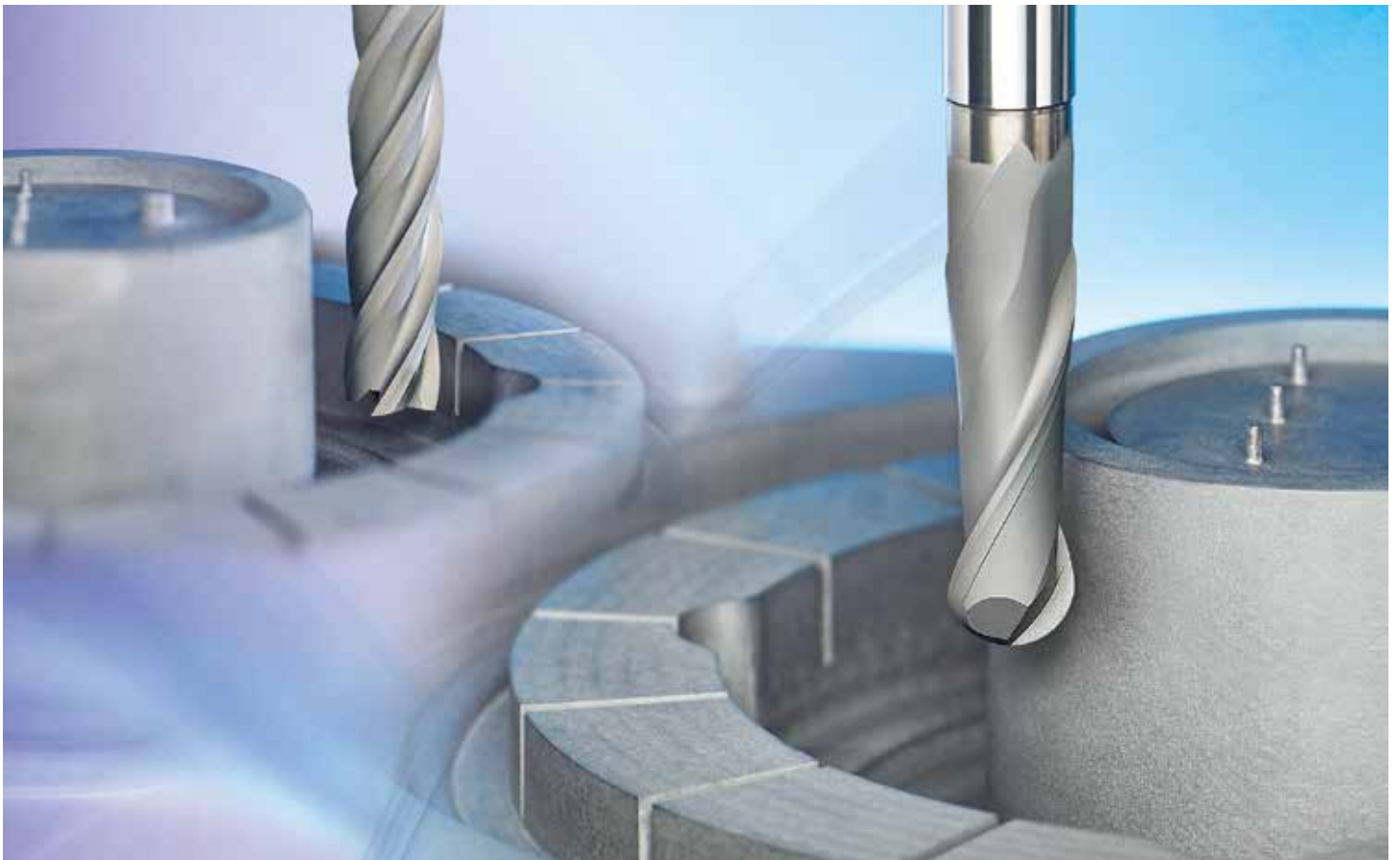
For machining graphite and ceramics

- ▣ **Increased wear resistance**

High hardness and high purity diamond coating for excellent wear resistance

- ▣ **Improved surface finish**

Tangential cutting edge geometries for excellent surface finish



D Endmill Series

For Machining Graphite and Ceramics Diamond Coated Endmill Series



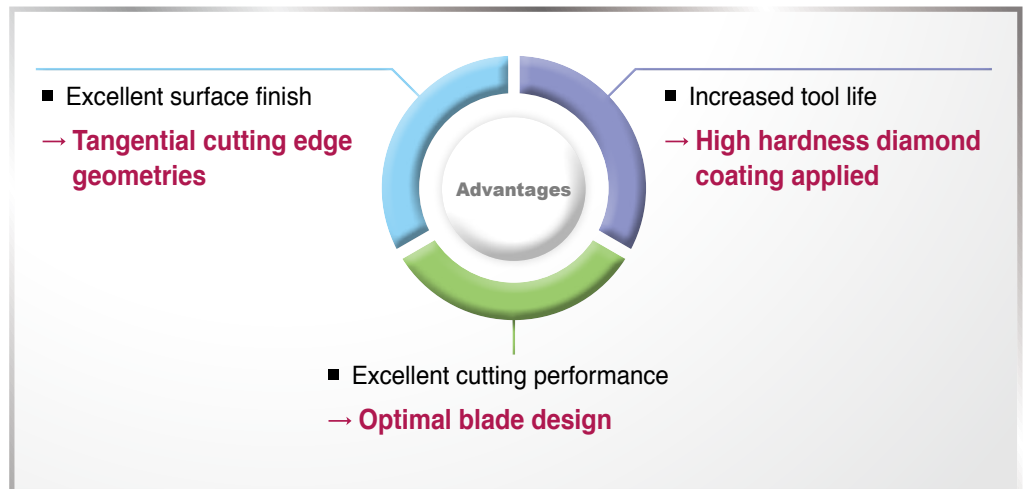
D Endmill For graphite and ceramics

Cutting tools made for **graphite** tend to have poor tool life during machining. Friction between graphite molecules and the relief surface of endmill cause early tool wear, and its high hardness is also responsible for the possible flaking of the diamond coating.

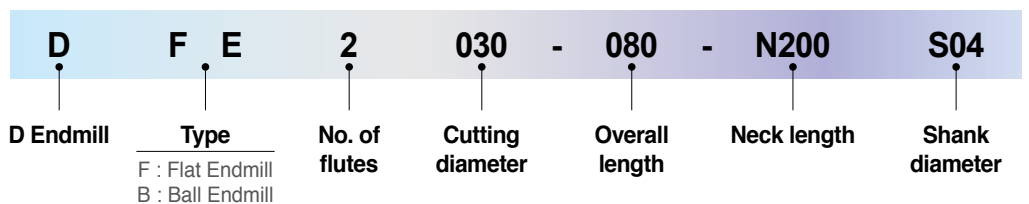
It is therefore important to develop a diamond coating that has high hardness and good adherence to the substrate. In return, this will reduce the occurrences of tool wear and flaking, resulting in an increased tool life.

The ND3000 is a new diamond coated grade with high hardness and high purity sp³ structure that improves wear resistance. It also offers higher resistance to flaking since it holds the coating and the substrate tightly together.

The D Endmill provides precise and sharp cutting performance thanks to optimized tangential cutting edge design. This versatile tool excels in graphite machining under complex conditions.



Code System



※ Radius and other form of endmills are made to order

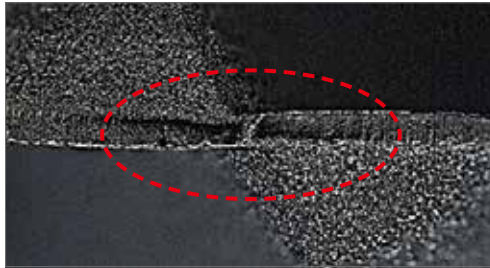
ND3000 (Diamond Coated Grade) N

Common Problems when Machining Graphite

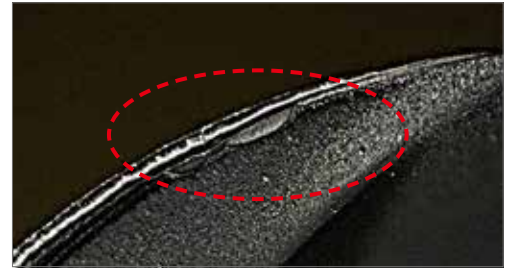
- Massive flank wear on relief surface due to continuous friction
- Coating flaking by repeated impacts between high hardness graphite workpiece and the cutting edges

Massive relief surface wear caused by the friction between graphite molecules and the tool

1. Massive flank wear



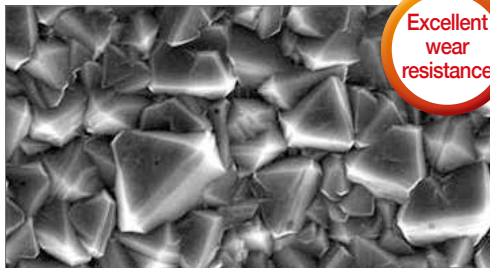
2. Flaking



Development of ND3000(Diamond Coated Grade)

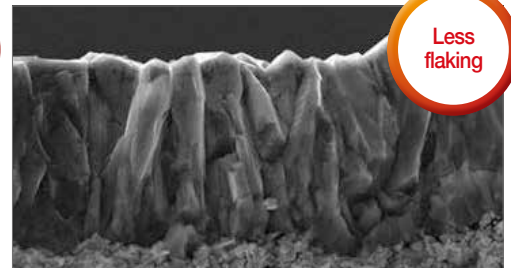
- High hardness diamond coating for machining graphite and ceramics
- Good adhesion strength for high speed and heavy duty machining

Surface of ND3000



→ **Excellent wear resistance** due to high hardness(Hv 10,000) diamond coating

Cross section of ND3000 coating

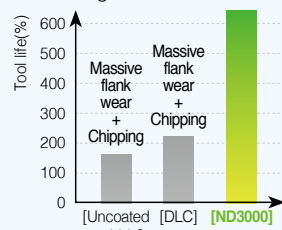


→ **Excellent adhesion strength** due to suitable substrate for diamond coating

Development Effects

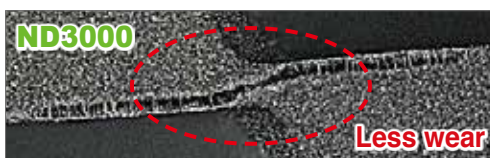
[Cutting performance]

• In graphite and special carbon machining



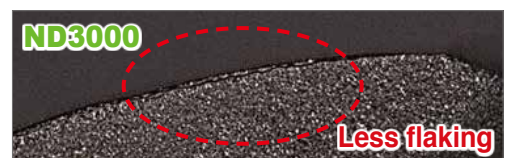
→ 6 times longer tool life compared to uncoated carbide

1. Less flank wear



→ **Reduced creation of massive flank wear** on the relief surface due to excellent wear resistance

2. Less edge flaking

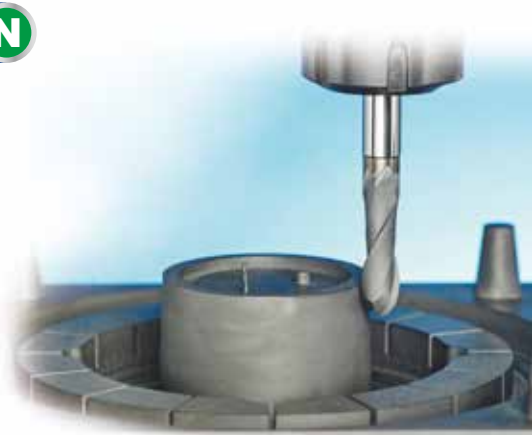


→ **Reduced coating delamination** due to excellent adhesion between coating and substrate

D Endmill Series

Diamond Coated Endmill N

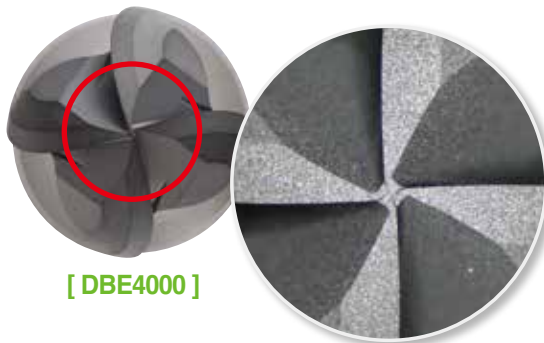
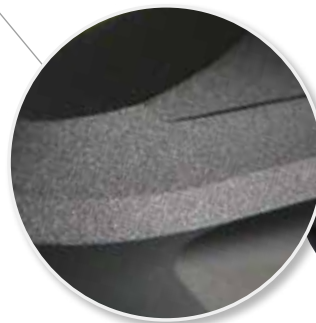
- Diamond coated endmill for graphite and ceramics
- Excellent wear resistance due to high hardness and high purity diamond coating
- Exceptional coating grip ideal for high speed and heavy duty machining
- Advanced surface finish and cutting performance thanks to sharp edges and tangential tool geometries



Features

Tangential cutting edge geometries

- One-Pass grinding system
- Prevents stepped cone on the machined surface
- 2-flutes and 4-flutes tooling with a ball nose



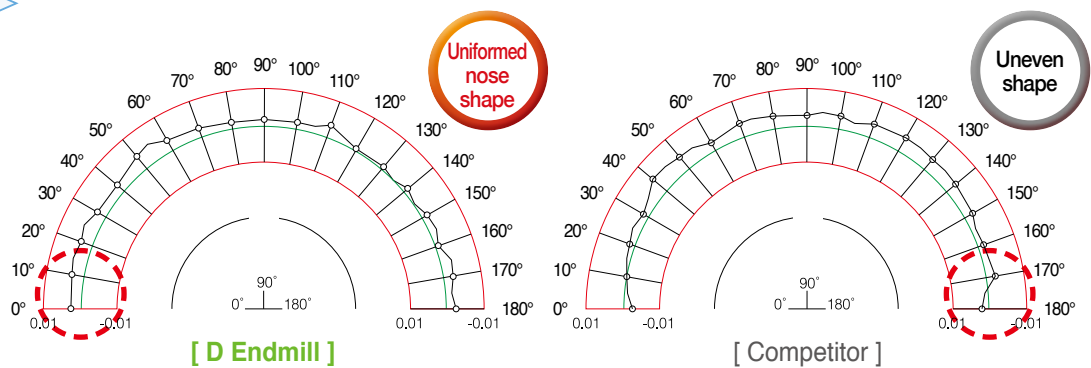
[DBE4000]

Center-matched ball shape (4-flutes)

- Ball point shape for high feed machining
- Improved rigidity and excellent surface finish

Uniformed nose shape
 → Prevents stepped cone on the machined surface for excellent surface finish

Measurement of Nose Radius



→ Tangential cutting edge geometries for uniformed nose radius shape ranging from 0° to 180°

➔ Application Examples



Graphite mold

- Cutting conditions $vc(m/min) = 100$, $fz(mm/t) = 0.11$, $ap(mm) = 0.26$, dry
- Tools DBE4060-110-N250S06

D Endmill

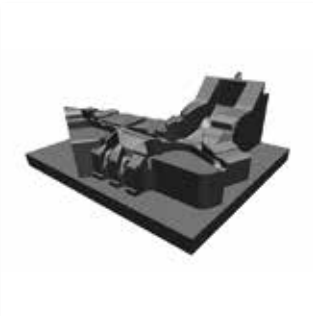
8 hours

Competitor

6.5 hours



➔ 20% longer cutting time than competitor's



Graphite mold

- Cutting conditions $vc(m/min) = 180$, $fz(mm/t) = 0.1$, $ap(mm) = 0.2$, dry
- Tools DBE2060-110-N250S06

D Endmill

10 hours

Competitor

8 hours



➔ 25% longer cutting time than competitor's



Graphite mold

- Cutting conditions $vc(m/min) = 300$, $fz(mm/t) = 0.1$, $ap(mm) = 0.15$, dry
- Tools DBE2060-080-N250S06

D Endmill

6 hours

Competitor

5 hours



➔ 25% longer cutting time than competitor's

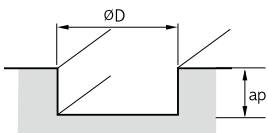


D Endmill Series

➤ Recommended Cutting Conditions (Flat type)

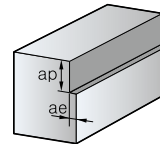
Tool	DFE2000 (Slotting)		DFE2000 (Shouldering)		DFE4000 (Shouldering)	
Workpiece	Graphite					
Conditions	RPM n(min ⁻¹)	Feed vf(mm/min)	RPM n(min ⁻¹)	Feed vf(mm/min)	RPM n(min ⁻¹)	Feed vf(mm/min)
Diameter(Ø)						
1	40,000	500	40,000	700	-	-
2	25,000	570	25,000	800	25,000	1,600
3	20,000	570	20,000	800	20,000	1,600
4	18,000	680	18,000	950	18,000	1,900
5	14,000	960	14,000	1,200	14,000	2,400
6	11,000	1,000	11,000	1,400	11,000	2,800
8	8,000	930	8,000	1,300	8,000	2,600
10	6,500	860	6,500	1,200	6,500	2,400
12	5,500	860	5,500	1,200	5,500	2,400

■ Slotting depth(ap)



- $D \leq \text{Ø}2.5$, $a_p = 0.3D$
- $D > \text{Ø}2.5$, $a_p = 0.5D$
- Workpiece should be clamped rigidly. In case of vibrations, reduce RPM and feed rate by the same ratio.

■ Shouldering depth(ap)

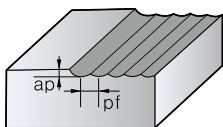


- $D \leq \text{Ø}2.5$, $a_p = 1.5D$, $a_e = 0.05D$
- $D > \text{Ø}2.5$, $a_p = 1.5D$, $a_e = 0.1D$
- Workpiece should be clamped rigidly. In case of vibrations, reduce RPM and feed rate by the same ratio.

➤ Recommended Cutting Conditions (Ball type)

Tool	DBE2000		DBE4000	
Workpiece	Graphite			
Conditions	RPM n(min ⁻¹)	Feed vf(mm/min)	RPM n(min ⁻¹)	Feed vf(mm/min)
Diameter(Ø)				
1	16,000	400	-	-
2	16,000	800	16,000	1,200
3	16,000	1,450	16,000	2,000
4	16,000	2,100	16,000	3,100
5	15,500	2,550	15,000	3,800
6	15,000	2,950	15,000	4,400
8	13,000	3,000	13,000	4,500
10	11,500	3,000	12,000	4,600
12	10,700	3,200	10,000	4,700

■ Depth of cut(ap)

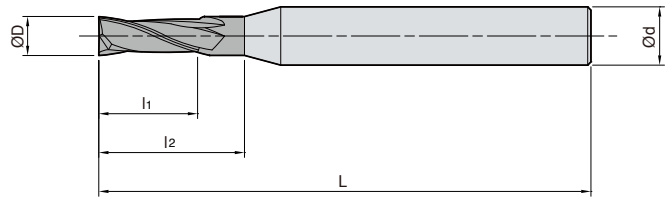
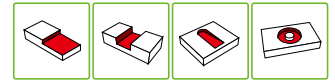


- $a_p = 0.2D$, $pf = 0.2D$
- Workpiece should be clamped rigidly. In case of vibrations, reduce RPM and feed rate by the same ratio.

* Notice

- Cutting conditions are up to the machine's condition and the shape of cutting.
- Workpiece should be clamped rigidly. In case of vibrations, reduce RPM and feed rate by the same ratio.
- When the overhang is longer than 3D, reduce RPM and feed rate

DFE2000 (Flat)



Helix Angle
30°

Grade
ND3000

h6
shank

ØD	Tolerance
~ Ø5.9	0.00 ~ -0.02
Ø6.0 ~	0.00 ~ -0.025

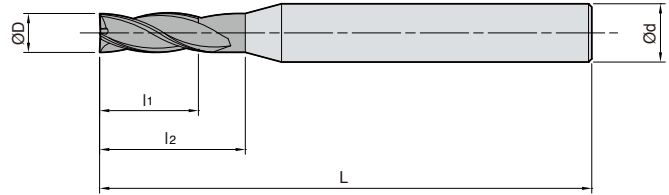
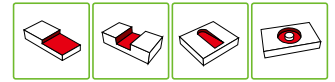
Workpiece				
Graphite	Ceramics	Aluminum	Copper	Plastic (GFRP)
◎	◎	○	○	○

(mm)

Designation	ØD	Ød	l ₁	l ₂	L
DFE					
2010-045-N050S04	1	4	3	5	45
2010-060-N050S04	1	4	3	5	60
2010-060-N100S04	1	4	3	10	60
2010-060-N150S04	1	4	3	15	60
2010-060-N200S04	1	4	3	20	60
2010-060-N250S04	1	4	3	25	60
2015-060-N050S04	1.5	4	4	5	60
2015-060-N100S04	1.5	4	4	10	60
2015-060-N150S04	1.5	4	4	15	60
2015-060-N200S04	1.5	4	4	20	60
2015-060-N250S04	1.5	4	4	25	60
2020-045-N080S04	2	4	6	8	45
2020-080-N080S04	2	4	6	8	80
2020-080-N100S04	2	4	6	10	80
2020-080-N150S04	2	4	6	15	80
2020-080-N200S04	2	4	6	20	80
2020-080-N250S04	2	4	6	25	80
2020-080-N300S04	2	4	6	30	80
2020-080-N400S04	2	4	6	40	80
2030-050-N100S06	3	6	9	10	50
2030-080-N100S04	3	4	9	10	80
2030-080-N200S04	3	4	9	20	80
2030-080-N250S04	3	4	9	25	80
2030-080-N300S04	3	4	9	30	80
2030-080-N400S04	3	4	9	40	80
2040-050-N160S06	4	6	12	16	50
2040-080-N160S04	4	4	12	16	80
2050-060-N200S06	5	6	15	20	60
2050-110-N200S06	5	6	15	20	110
2060-060-N180S06	6	6	18	-	60
2060-110-N250S06	6	6	18	25	110
2060-150-N250S06	6	6	18	25	150
2080-070-N250S08	8	8	25	-	70
2080-150-N400S08	8	8	25	40	150
2100-080-N300S10	10	10	30	-	80
2100-150-N500S10	10	10	30	50	150
2120-080-N350S12	12	12	35	-	80
2120-150-N600S12	12	12	35	60	150

D Endmill Series

DFE4000 (Flat)



Helix Angle
30°

Grade
ND3000

h6
shank

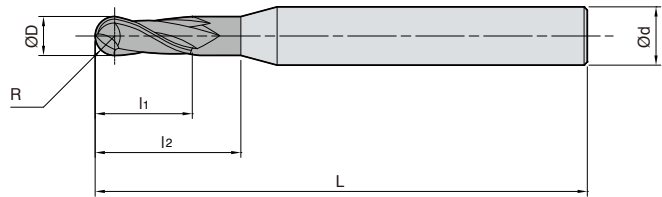
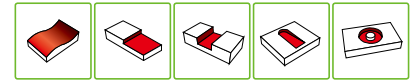
ØD	Tolerance
~ Ø5.9	0.00 ~ -0.02
Ø6.0 ~	0.00 ~ -0.025

Workpiece				
Graphite	Ceramics	Aluminum	Copper	Plastic (GFRP)
◎	◎	○	○	○

(mm)

Designation	ØD	Ød	l1	l2	L	
DFE 4	4020-045-N060S04	2	4	6	8	45
	4020-060-N100S04	2	4	10	12	60
	4030-050-N100S06	3	6	10	12	50
	4030-060-N150S04	3	4	15	18	60
	4040-050-N150S06	4	6	15	18	50
	4040-080-N200S04	4	4	20	-	80
	4060-060-N180S06	6	6	18	-	60
	4060-110-N300S06	6	6	30	-	110
	4060-150-N300S06	6	6	30	-	150
	4080-070-N250S08	8	8	25	-	70
	4080-110-N400S08	8	8	40	-	110
	4080-150-N400S08	8	8	40	-	150
	4100-080-N250S10	10	10	25	-	80
	4100-110-N400S10	10	10	40	-	110
	4100-150-N500S10	10	10	50	-	150
	4120-080-N300S12	12	12	30	-	80
	4120-110-N400S12	12	12	40	-	110
	4120-150-N500S12	12	12	50	-	150

DBE2000 (Ball)



Helix Angle
30°

Grade
ND3000

h6
shank

ØD	Tolerance
~ Ø5.9	0.00 ~ -0.02
Ø6.0 ~	0.00 ~ -0.025

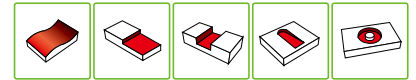
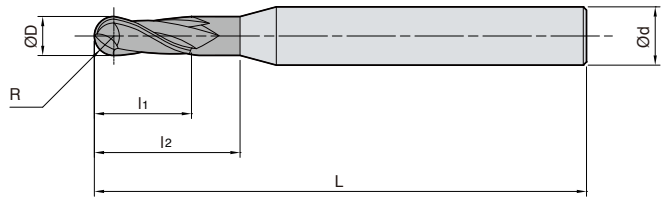
Workpiece				
Graphite	Ceramics	Aluminum	Copper	Plastic (GFRP)
◎	◎	○	○	○

(mm)

Designation	R	ØD	Ød	l ₁	l ₂	L
DBE						
2006-045-N020S04	0.3	0.6	4	2	2	45
2006-045-N050S04	0.3	0.6	4	2	5	45
2006-045-N080S04	0.3	0.6	4	2	8	45
2006-045-N100S04	0.3	0.6	4	2	10	45
2008-045-N030S04	0.4	0.8	4	2.5	3	45
2008-045-N050S04	0.4	0.8	4	2.5	5	45
2008-045-N100S04	0.4	0.8	4	2.5	10	45
2010-060-N030S04	0.5	1	4	3	3	60
2010-060-N050S04	0.5	1	4	3	5	60
2010-060-N080S04	0.5	1	4	3	8	60
2010-060-N100S04	0.5	1	4	3	10	60
2010-060-N120S04	0.5	1	4	3	12	60
2010-060-N150S04	0.5	1	4	3	15	60
2010-060-N200S04	0.5	1	4	3	20	60
2010-080-N250S04	0.5	1	4	3	25	80
2010-080-N300S04	0.5	1	4	3	30	80
2010-080-N350S04	0.5	1	4	3	35	80
2010-080-N400S04	0.5	1	4	3	40	80
2015-060-N050S04	0.75	1.5	4	4	5	60
2015-080-N100S04	0.75	1.5	4	4	10	80
2015-080-N150S04	0.75	1.5	4	4	15	80
2015-080-N200S04	0.75	1.5	4	4	20	80
2015-080-N250S04	0.75	1.5	4	4	25	80
2015-080-N300S04	0.75	1.5	4	4	30	80
2015-080-N350S04	0.75	1.5	4	4	35	80
2015-080-N400S04	0.75	1.5	4	4	40	80
2020-060-N080S04	1	2	4	6	8	60
2020-080-N100S04	1	2	4	6	10	80
2020-080-N150S04	1	2	4	6	15	80
2020-080-N200S04	1	2	4	6	20	80
2020-080-N250S04	1	2	4	6	25	80
2020-080-N300S04	1	2	4	6	30	80
2020-080-N350S04	1	2	4	6	35	80
2020-100-N400S04	1	2	4	6	40	100
2020-100-N450S04	1	2	4	6	45	100
2020-100-N500S04	1	2	4	6	50	100

D Endmill Series

DBE2000 (Ball)



Helix Angle
30°

Grade
ND3000

h6
shank

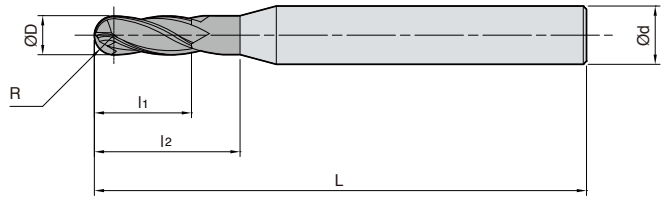
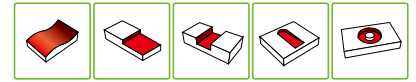
ØD	Tolerance
~ Ø5.9	0.00 ~ -0.02
Ø6.0 ~	0.00 ~ -0.025

Workpiece				
Graphite	Ceramics	Aluminum	Copper	Plastic (GFRP)
◎	◎	○	○	○

(mm)

Designation	R	ØD	Ød	l1	l2	L
DBE						
2030-060-N100S04	1.5	3	4	9	10	60
2030-100-N150S04	1.5	3	4	9	15	100
2030-100-N200S04	1.5	3	4	9	20	100
2030-100-N250S04	1.5	3	4	9	25	100
2030-100-N300S04	1.5	3	4	9	30	100
2030-100-N350S04	1.5	3	4	9	35	100
2030-100-N400S04	1.5	3	4	9	40	100
2030-100-N500S04	1.5	3	4	9	50	100
2040-060-N160S04	2	4	4	12	16	60
2040-080-N160S04	2	4	4	12	16	80
2040-080-N300S04	2	4	4	12	30	80
2040-100-N160S04	2	4	4	12	16	100
2040-100-N400S04	2	4	4	12	40	100
2040-130-N160S04	2	4	4	12	16	130
2040-130-N400S04	2	4	4	12	40	130
2050-110-N200S06	2.5	5	6	15	20	110
2060-080-N250S06	3	6	6	20	25	80
2060-110-N250S06	3	6	6	20	25	110
2060-150-N300S06	3	6	6	20	30	150
2080-080-N300S08	4	8	8	25	30	80
2080-110-N300S08	4	8	8	25	30	110
2080-150-N500S08	4	8	8	25	50	150
2080-200-N400S08	4	8	8	25	40	200
2100-080-N400S10	5	10	10	30	40	80
2100-110-N400S10	5	10	10	30	40	110
2100-150-N600S10	5	10	10	30	60	150
2100-200-N500S10	5	10	10	30	50	200
2120-110-N500S12	6	12	12	35	50	110
2120-150-N500S12	6	12	12	35	50	150
2120-200-N600S12	6	12	12	35	60	200

DBE4000 (Ball)



Helix Angle
30°


Grade
ND3000

h6
shank

ØD	Tolerance
~ Ø5.9	0.00 ~ -0.02
Ø6.0 ~	0.00 ~ -0.025

Workpiece				
Graphite	Ceramics	Aluminum	Copper	Plastic (GFRP)
◎	◎	○	○	○

(mm)

Designation	R	ØD	Ød	l ₁	l ₂	L
DBE						
 4020-060-N080S04	1	2	4	6	8	60
4020-080-N100S04	1	2	4	6	10	80
4020-080-N200S04	1	2	4	6	20	80
4020-080-N300S04	1	2	4	6	30	80
4020-080-N400S04	1	2	4	6	40	80
4030-060-N100S04	1.5	3	4	9	10	60
4030-100-N150S04	1.5	3	4	9	15	100
4030-100-N200S04	1.5	3	4	9	20	100
4030-100-N300S04	1.5	3	4	9	30	100
4030-100-N400S04	1.5	3	4	9	40	100
4030-100-N500S04	1.5	3	4	9	50	100
4040-060-N160S04	2	4	4	12	16	60
4040-080-N160S04	2	4	4	12	16	80
4040-100-N160S04	2	4	4	12	16	100
4040-130-N160S04	2	4	4	12	16	130
4060-080-N250S06	3	6	6	20	25	80
4060-110-N250S06	3	6	6	20	25	110
4060-150-N300S06	3	6	6	20	30	150
4080-080-N300S08	4	8	8	25	30	80
4080-110-N300S08	4	8	8	25	30	110
4080-150-N350S08	4	8	8	25	35	150
4080-200-N400S08	4	8	8	25	40	200
4100-080-N350S10	5	10	10	30	35	80
4100-110-N350S10	5	10	10	30	35	110
4100-150-N400S10	5	10	10	30	40	150
4100-200-N500S10	5	10	10	30	50	200
4120-110-N500S12	6	12	12	35	50	110
4120-150-N500S12	6	12	12	35	50	150
4120-200-N600S12	6	12	12	35	60	200

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