

F

ENDMILLS

Korloy Endmills, with New technology and our technical know-how,
are the best for increasing productivity and machinability



Technical Information for Endmills

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- F04 KORLOY Endmills

Solid Endmills

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Solid Endmills

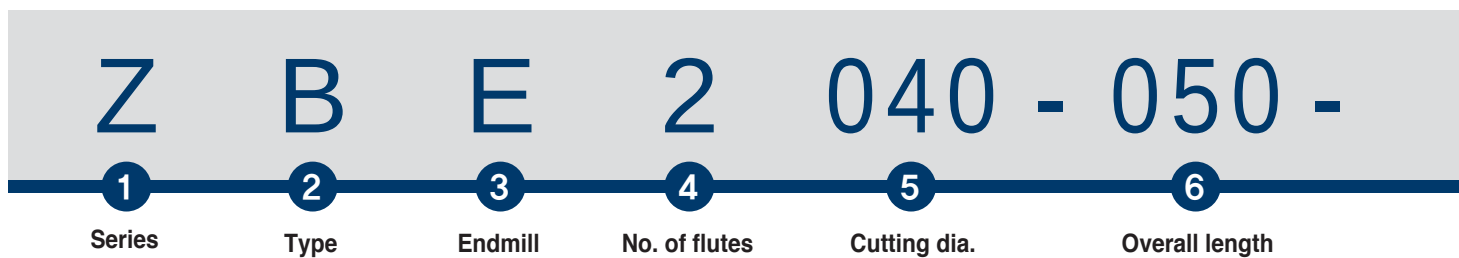
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Brazed Endmills

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Special Endmill order Form

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1 Series
Z B E 2 040 - 050 - R T - V N S

IP, Z: Infinity-Max Endmill
 HP, P: High performance-Max Endmill
 C: Copper-Max Endmill
 D: Dia coated-Max Endmill
 V: Variable Endmill
 FM: Feed-up Endmill

SSEA, AP: Aluminum Endmill
 SP: Stainless Endmill
 CC: Composite Rough Endmill
 T: Dental Endmill

2 Type
Z B E 2 040 - 050 - R T - V N S

Flat type
 F

Ball type
 B

Radius type
 R

3 Endmill
Z B E 2 040 - 050 - R T - V N S

4 No. of flutes
Z B E **2** 040 - 050 - R T - V N S

2 Flutes

 2

3 Flutes

 3

4 Flutes

 4

6 Flutes

 6

5 Cutting dia
Z B E 2 **040** - 050 - R T - V N S

Notation	ØD (mm)
040	Ø4.0
060	Ø6.0
080	Ø8.0
100	Ø10.0

6 Overall length
Z B E 2 040 - **050** - R T - V N S

Overall length	
Notation	L (mm)
050	50
080	80
100	100

※ The above code system is not applied for SSEA and ZSE

R02 T00 - V05 N12 S06

7

Corner radius

8

Taper angle

9

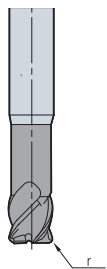
Taper length

10

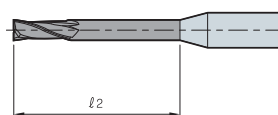
Neck length

11

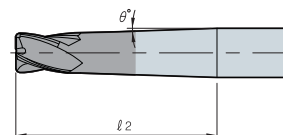
Shank diameter

7**Corner radius**Z B E 2 040 - 050 - **R** T - V N S

Corner radius	
Notation	R (mm)
R02	r 0.2
R05	r 0.5
R10	r 1.0
R15	r 1.5

10**Neck length**Z B E 2 040 - 050 - R T - V **N** S

Long Neck



Taper Long Neck

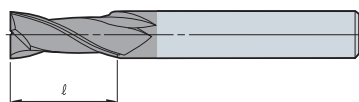
 l_2 (mm): Neck LengthT (θ°): Taper Angle

Long neck	
Notation	l_2 (mm)
N05	5
N08	8
N10	10
N12	12

Taper long neck	
Notation	$l_2 + T(\theta^\circ)$
N0510	5+1°
N0815	8+1.5°
N1020	10+2°
N1225	12+2.5°

8**Taper angle**Z B E 2 040 - 050 - R **T** - V N ST (θ°): Taper Angle

Taper angle	
Notation	T (θ°)
T10	1°
T15	1.5°
T20	2°

9**Taper length**Z B E 2 040 - 050 - R T - **V** N S

Taper length	
Notation	(mm)
V05	5
V10	10
V15	15

11**Shank diameter**Z B E 2 040 - 050 - R T - V N **S**

Shank diameter	
Notation	Ød (mm)
S06	Ø6
S08	Ø8
S10	Ø10
S12	Ø12
S16	Ø16

※ This code system is also for special endmills

F KORLOY Endmills

Type	Shape	Designation	Substrate	Figure	Coated	Used	No. of flute	Size		Workpiece						page
								Min	Max	P	M	K	N	S	H	
										Steel	Stainless steel	Cast iron	Non-ferrous metal	High resistant alloy, titanium alloy	Hardened steel	
H Endmill new	Ball	PBE2000	PC303S		○	High speed High hardness	2	0.5	12	◎		◎		○	◎	F12
	Radius	PRE4000	PC310U		○	High speed High hardness	4	3	12	◎		◎		○	◎	F13
V Endmill	Flat	VFE4000	PC215F		○	General	4	2.5	16	◎	○	○		○	○	F16
Z Endmill new	Flat	ZFE2000	PC315E		○	General	2	1	16	◎	○	◎		○		F20
		ZFE4000	PC315E		○	General	4	1	16	◎	○	◎		○		F21
	Short flat	ZSFE2000	PC315E		○	General	2	1	12	◎	○	◎		○		F22
		ZSFE4000	PC315E		○	General	4	1	12	◎	○	◎		○		F22
	Ball	ZBE2000	PC315E		○	General	2	1	12	◎	○	◎		○		F23
F Endmill	Standard	FME4000	PC203F		○	High speed High hardness	4	6	12	○		○		◎	◎	F26
	Long	FMLE4000	PC203F		○	High speed High hardness	4	6	12	○		○		◎	◎	F26
T Endmill new	Ball	TZBE	ND3000		○	Dental, Zirconia	2	0.6	3					◎		F27
		TTBE	PC2510		○	Dental, Metal	2	0.6	3						◎	F27
		TWBE	H01		—	Dental, Wax	2	0.6	3					◎		F27
I+ Endmill	Flat	IPFE2000	PC320		○	General	2	1	20	◎	○	◎		○		F33
		IPFE4000	PC320		○	General	4	1	20	◎	○	◎		○		F35
	Long flat	IPLFE2000	PC320		○	General	2	1	20	◎	○	◎		○		F34
		IPLFE4000	PC320		○	General	4	1	20	◎	○	◎		○		F36
	Ball	IPBE2000	PC320		○	General	2	1	20	◎	○	◎		○		F37

◎: Excellent ○: Good



Type	Shape	Designation	Substrate	Figure	Coated	Used	No. of flute	Size		Workpiece						page
								Min	Max	P	M	K	N	S	H	
										Steel	Stainless steel	Cast iron	Non-ferrous metal	Heat resistant alloy	Titanium alloy	
I + Endmill	Ball	IPBE4000	PC320		○	General	4	1	20	◎	○	◎		○		F39
	Long ball	IPLBE2000	PC320		○	General	2	1	16	◎	○	◎		○		F38
	Radius	IPRE2000	PC320		○	General	2	1	12	◎	○	◎		○		F40 F41
		IPRE4000	PC320		○	General	4	2	12	◎	○	◎		○		F43
	Long radius	IPLRE2000	PC320		○	General	2	3	12	◎	○	◎		○		F42
		IPLRE4000	PC320		○	General	4	3	12	◎	○	◎		○		F44
Z + Endmill new	Flat	ZPFE2000	PC320U		○	General	2	1	20	◎	○	◎		○		F48
	Short flat	ZPSFE2000	PC320U		○	General	2	1	16	◎	○	◎		○		F49
	Long flat	ZPLFE2000	PC320U		○	General	2	2	20	◎	○	◎		○		F49
	Long flute	ZPLFE2000	PC320U		○	General	2	2	20	◎	○	◎		○		F50
	Flat	ZPFE4000	PC320U		○	General	4	1	20	◎	○	◎		○		F51
	Short flat	ZPSFE4000	PC320U		○	General	4	1	16	◎	○	◎		○		F52
	Long flat	ZPLFE4000	PC320U		○	General	4	2	20	◎	○	◎		○		F53
	Long flute	ZPLFE4000	PC320U		○	General	4	1	20	◎	○	◎		○		F54
	Flat	ZPFE3000	PC320U		○	General	3	2	25	◎	○	◎		○		F55
		ZPFE6000	PC320U		○	General	6	6	20	◎	○	◎		○		F55
	Ball	ZPBE2000	PC320U		○	General	2	0.8	20	◎	○	◎		○		F56
	Long ball	ZPLBE2000	PC320U		○	General	2	2	12	◎	○	◎		○		F57

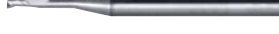
◎: Excellent ○: Good

F KORLOY Endmills

Type	Shape	Designation	Substrate	Figure	Coated	Used	No. of flute	Size		Workpiece						page
								Min	Max	P	M	K	N	S	H	
										Steel	Stainless steel	Cast iron	Non-ferrous metal	Heat resistant alloy, titanium alloy	Hardened steel	
Z+ Endmill	Ball	ZPBE4000	PC320U		○	General	4	2	20	◎	○	◎	○	○		F57
	Radius	ZPRE2000	PC320U		○	General	2	1	16	◎	○	◎	○	○		F58
	Long radius	ZPLRE2000	PC320U		○	General	2	6	16	◎	○	◎	○	○		F59
	radius	ZPRE4000	PC320U		○	General	4	1.5	16	◎	○	◎	○	○		F60
	Long radius	ZPLRE4000	PC320U		○	General	4	6	16	◎	○	◎	○	○		F61
S+ Endmill	Flat	SPFE4000	PC320S		—	STS	4	1	12	○	◎	○	○	◎		F64
	Long flat	SPLFE4000	PC320S		—	STS	4	1	12	○	◎	○	○	◎		F64
R+ Endmill	Roughing	EM09CA	PC30T		○	General	4	5	20	◎	○	◎	○	○		F70
		EM11CA	FN30T		—	Aluminum	3	6	25				◎			F70
		EM36CA	PC30T		○	General	4	5	20	◎	○	◎	○	○		F71
		EM37CA	PC30T		○	General	4	5	20	◎	○	◎	○	○		F71
		EM38CA	PC40T		○	General	4	5	20	◎	○	◎	○	○		F72
		EM43CA	PC30T		○	General	4	5	20	◎	○	◎	○	○		F72
		EM11PM	HC30T		○	General	4	6	20	◎	○	◎	○	○		F73
		EM16PM	HC30T		○	General	4	6	20	◎	○	◎	○	○		F73
		EM17PM	HC30T		○	General	4	6	20	◎	○	◎	○	○		F74
Solid Endmills for aluminum	Flat	EM06H9M	HC10T HC20T		○	General	4	6	50	◎	○	◎	○	○		F75
		SSEA2000	H01 PD3000		— (○)	Aluminum	2	1	20	○			◎			F77

◎: Excellent ○: Good



Type	Shape	Designation	Substrate	Figure	Coated	Used	No. of flute	Size		Workpiece						page
								Min	Max	P	M	K	N	S	H	
										Steel	Stainless steel	Cast iron	Non-ferrous metal	Heat resistant alloy	Titanium alloy	
Solid Endmills for aluminum	Flat	SSEA3000	H01 PD3000		— (○)	Aluminum	3	2	16	○			◎			F77
	Ball	SSBEA2000	H01 PD3000		— (○)	Aluminum	2	1	20	○			◎			F78
A+ Endmill	Flat	APFE2000	H05S		—	Aluminum	2	2.5	20	○			◎			F81
		APFE3000	H05S		—	Aluminum	3	2.5	20	○			◎			F81
	Long flat	APLFE2000	H05S		—	Aluminum	2	3	20	○			◎			F82
		APLFE3000	H05S		—	Aluminum	3	3	20	○			◎			F82
	Ball	APBE2000	H05S		—	Aluminum	2	1	12	○			◎			F83
	Roughing	APRE3000	H05S		—	Aluminum	3	4	25	○			◎			F83
C-Max	Flat	CFE2000	PC210C		○	Copper, Copper alloy	2	1.0	12	○			◎			F85
	Long neck flat	CFNE2000	PC210C		○	Copper, Copper alloy	2	0.5	4	○			◎			F85
	Ball	CBE2000	PC210C		○	Copper, Copper alloy	2	1.0	12	○			◎			F86
	Long neck ball	CBNE2000	PC210C		○	Copper, Copper alloy	2	0.5	4	○			◎			F86
	Radius	CRE2000	PC210C		○	Copper, Copper alloy	2	2.0	12	○			◎			F87
	Long neck radius	CRNE2000	PC210C		○	Copper, Copper alloy	2	1.0	4	○			◎			F87
D Endmill new	Flat	DFE2000	ND3000		○	Graphite, Ceramics	2	1.0	12				◎			F90
		DFE4000	ND3000		○	Graphite, Ceramics	4	2	12				◎			F91
	Ball	DBE2000	ND3000		○	Graphite, Ceramics	2	0.6	12				◎			F92 F93
		DBE4000	ND3000		○	Graphite, Ceramics	4	2	12				◎			F94

◎: Excellent ○: Good

F KORLOY Endmills

Type	Shape	Designation	Substrate	Figure	Coated	Used	No. of flute	Size		Workpiece						page
								Min	Max	P	M	K	N	S	H	
										Steel	Stainless steel	Cast iron	Non-ferrous metal	Heat resistant alloy, titanium alloy	Hardened steel	
Composite Router Endmill	Flat	CCDR4000	ND2100		○	Composite CFRP, GFRP	4	6	8				◎			F96
		CCDR6000	ND2100		○	Composite CFRP, GFRP	6	10	12				◎			F96
		CCR2000	ND2100		○	Composite CFRP, GFRP	2	4	12				◎			F97
		CCLR4000	ND2100		○	Composite CFRP, GFRP	4	4	12				◎			F98
		CCRR6000	ND2100		○	Composite CFRP, GFRP	6	6	8				◎			F99
		CCRR8000	ND2100		○	Composite CFRP, GFRP	8	10	12				◎			F99
PCD Endmill	Flat	PDE1000	DP200		—	Nonferrous, High speed	1	4.6	6				◎			F101
		PDE2000	DP200		—	Nonferrous, High speed	2	6.0	12				◎			F101
Brazed Endmill	Flat	ZSE200	FCC PC221F		— (○)	Cast iron, Steel	2	14	50	○	○	◎		○		F104
		ZSE300	FCC PC221F		— (○)	Cast iron, Steel	3	14	50	○	○	◎		○		F104 F105
		ZSE400	FCC PC221F		— (○)	Cast iron, Steel	4	14	50	○	○	◎		○		F105
		ZSE600	FCC PC221F		— (○)	Cast iron, Steel	6	34	50	○	○	◎		○		F105
		ZSEA200	FCC		—	Aluminum, Copper	2	15	50				◎			F106
	Long flat	ZSEL200	FCC PC221F		—	Cast iron, Steel	2	14	50	○	○	◎		○		F107
		ZSEL400	FCC PC221F		—	Cast iron, Steel	4	16	40	○	○	◎		○		F107
		ZSEXL200	FCC PC221F		—	Cast iron, Steel	2	20	25	○	○	◎		○		F107
	Ball	ZSBE200	FCC PC221F		—	Cast iron, Steel	2	13	50	○	○	◎		○		F108

◎: Excellent ○: Good



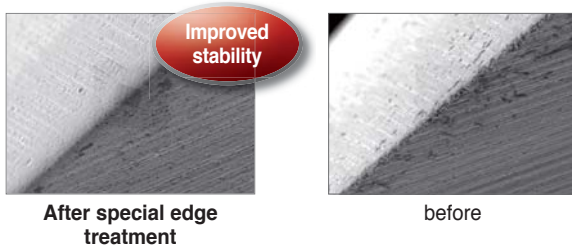
Endmill for high speed machining for high hardened steel

H Endmill **new**

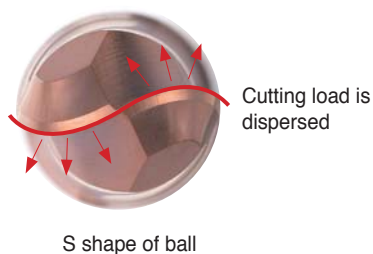
- For cutting high hardened and heat-treated steel under HRC70
- New coating technology improves wear resistance
- A new shape improves machinability
- High speed and highly accurate machining available

Features

- New grade (PC303S, PC310U) - Ultra fine substrate and AlTiSiN coating guarantee excellent wear resistance
- Special edge treatment - Special cutting edge design was applied for less chipping and longer tool life
- High accuracy with tolerance h5 - High quality production system enables tolerance-h5 throughout the whole series

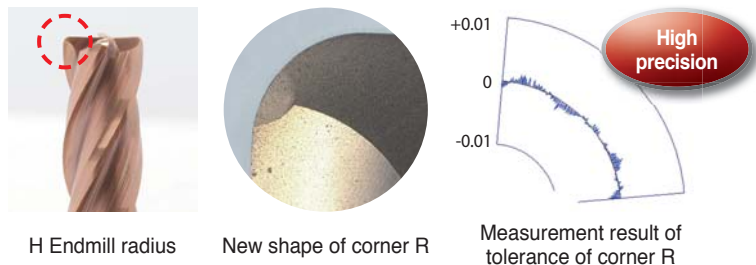


PBE (Ball)



- The S shape of ball disperses cutting loads
- The tolerance of ball R is under ± 0.005 mm

PRE (Radius)

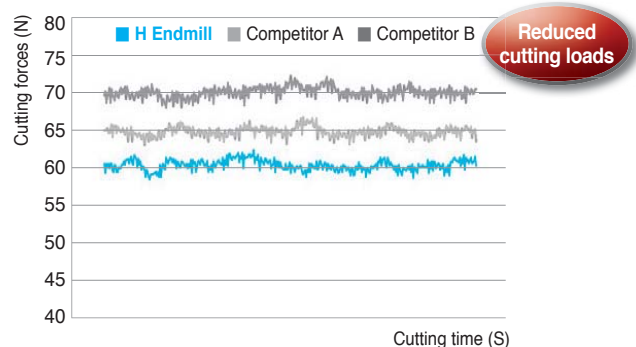


- The new shape of corner R reduces cutting loads
- The tolerance of corner R is under ± 0.005 mm

Performance evaluation

- **Workpiece** STD11 (HRC60)
- **Cutting conditions** Diameter = $\varnothing 8.0$, n (min^{-1}) = 4,000, vc (m/min) = 100
 vf (mm/min) = 800, fz (mm/t) = 0.05
 ap (mm) = 8.0, ae (mm) = 0.25, dry
- **Tools** PRE4080-100-R05

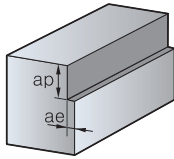
* Special cutting edge design reduces cutting loads and prolongs tool life



Recommended cutting conditions (PRE4000 radius)

Workpiece Conditions Diameter (Ø)	Pre-hardened steel (HrC35~45)		Hardened steel (HrC45~55)		High hardened steel (HrC55~70)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
3	17,300	1,250	11,500	840	7,500	256
4	13,200	1,300	8,800	880	5,600	268
5	12,500	1,500	8,300	1,000	5,100	296
6	10,350	1,400	6,900	950	4,200	280
8	7,800	1,350	5,200	900	3,200	264
10	6,150	1,260	4,100	840	2,550	248
12	5,250	1,260	3,500	840	2,100	240

Application tip



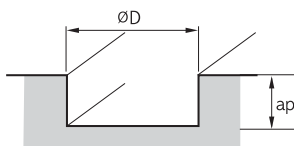
- Shouldering depth (ap) and radial depth (ae)
 - $ap = 0.1D$
 - $ae = 0.03D$

* Workpiece should be clamped rigidly. In case of vibration, reduce R.P.M and feed rate by the same ratio

Recommended cutting conditions (PRE4000 radius)

Workpiece Conditions Diameter (Ø)	Pre-hardened steel (HrC35~45)		Hardened steel (HrC45~55)		High hardened steel (HrC55~70)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
3	17,300	544	11,500	336	7,500	128
4	13,200	560	8,800	352	5,600	136
5	12,500	644	8,300	400	5,100	144
6	10,350	616	6,900	384	4,200	144
8	7,800	576	5,200	356	3,200	132
10	6,150	544	4,100	332	2,550	124
12	5,250	544	3,500	332	2,100	124

Application tip

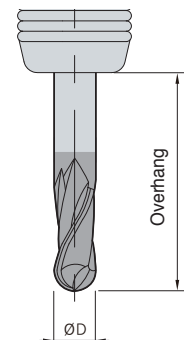


- Slotting depth (ap)
 - $ap = 0.05D$
 - $ae = 1.0D$

* Workpiece should be clamped rigidly. In case of vibration, reduce R.P.M and feed rate by the same ratio

Cutting condition by overhang

- Cutting conditions of the shank taper type in case of being clamped at neck
 - When the overhang is increased by 1D, decrease R.P.M and feed 10%
- In case of the straight type adjust conditions according to the overhang
 - Ex: When the overhang is 3D and is increased by 1D, decrease R.P.M and feed 10%



Notice

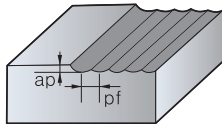
- Cutting conditions are up to the machine's condition and the shape of cutting
- Use cutting fluid that is proper to the workpiece and produces few temperature reactions



Recommended cutting conditions (PBE2000 ball)

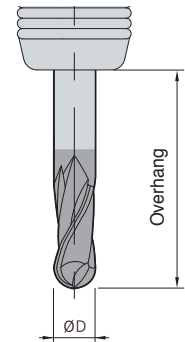
Workpiece Conditions Diameter(Ø)	Pre-hardened steel (HrC35~45)		Hardened steel (HrC45~55)		High hardened Steel (HrC55~HrC70)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
0.5	35,000	1,470	31,500	1,330	28,000	1,050
1	35,000	2,940	31,500	2,660	28,000	2,000
1.2	33,600	3,010	30,100	2,695	26,600	2,100
1.5	33,600	3,150	30,100	2,800	25,900	2,150
2	33,460	3,360	28,000	2,800	24,500	2,200
2.5	25,900	3,710	22,400	2,800	17,500	2,200
3	22,260	3,710	18,550	2,800	16,500	2,200
4	16,730	3,710	14,000	2,800	13,000	2,200
5	17,800	4,900	15,000	3,750	12,500	2,100
6	13,400	4,100	11,000	3,100	10,000	2,500
8	10,700	3,500	9,000	2,700	8,000	2,150
10	8,900	3,100	7,500	2,400	6,600	1,900
12	6,680	2,500	5,600	1,900	5,000	1,550

Application tip



- $ap = 0.02D$
- $pf = 0.05D$

* Workpiece should be clamped rigidly. In case of vibration, reduce R.P.M and feed rate by the same ratio



Cutting condition by overhang

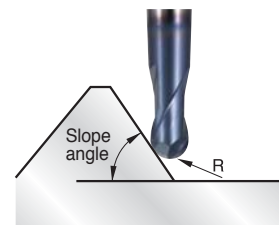
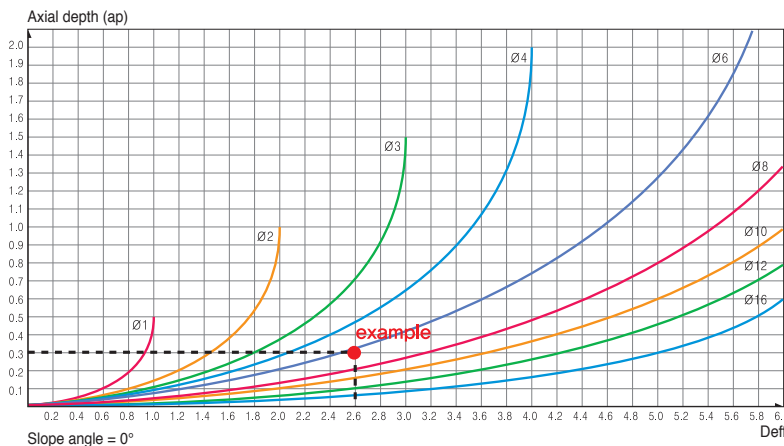
- Cutting conditions of the shank taper type in case of being clamped at neck
 - When the overhang is increased by 1D, decrease R.P.M and feed 10%
- In case of the straight type adjust conditions according to the overhang
 - Ex: When the overhang is 3D and is increased by 1D, decrease R.P.M and feed 10%

Cutting speed formulas (Ball endmills)

- Efficient cutting speed $V_{eff} = (\pi \times Deff \times n)/1000$ ($n = \text{min}^{-1}$)
- Efficient diameter $Deff$ calculation formula $Deff = (2\sqrt{ap(D-ap)} \times \alpha)$
 $D = \varnothing$ (Tool diameter), $Deff$ = Efficient diameter
- Efficient cutting speed formulas: When slope $\varnothing$ is 0° $V_{eff} = (\pi \times Deff \times n)/1000$
 $Deff$ = Efficient, diameter Calculate $Deff$ as ap with various ball endmills

α : $\alpha = 1$	Slope angle $\theta = 0^\circ$
$\alpha = 1.2$	Slope angle $\theta = 7^\circ$
$\alpha = 1.5$	Slope angle $\theta = 15^\circ$
$\alpha = 1.7$	Slope angle $\theta = 30^\circ$
$\alpha = 2.17$	Slope angle $\theta = 45^\circ$
$\alpha = 2.3$	Slope angle $\theta = 60^\circ$

Cutting speed formulas (Ball endmills, slope angle = 0°)

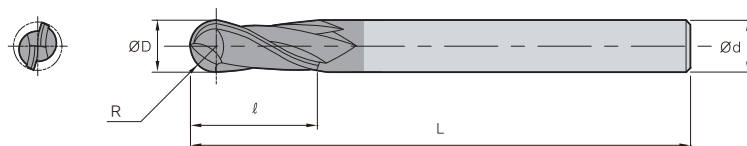


Ex) Diameter: 6 mm, $ap = 0.3$ mm,
 $Deff = 2.6$ mm, $N = 14,000$ (min^{-1})
 Slope angle 0° : $V_{eff} = 113.7$ (m/min)
 Slope angle 15° : $V_{eff} = 113.7 \times 1.5 = 170.6$ (m/min)

Notice

- Cutting conditions are up to the machine's condition and the shape of cutting
- Use cutting fluid that is proper to the workpiece and produces few temperature reactions

PBE2000 (Ball)



ØD	Tolerance
~Ø5.9	0.00~-0.015
Ø6.0~	0.00~-0.025

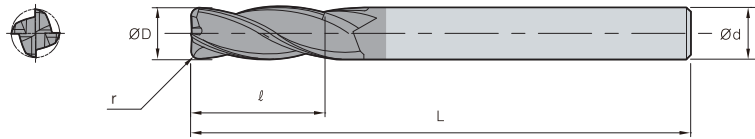


(mm)

Designation	R	ØD	Ød	ℓ	L
PBE					
2 2005-040	0.25	0.5	6	1	40
2010-050	0.5	1	6	2.5	50
2012-050	0.6	1.2	6	3	50
2015-050	0.75	1.5	6	4	50
2020-050	1	2	6	5	50
2025-060	1.25	2.5	6	7	60
2030-060	1.5	3	6	8	60
2040-070	2	4	6	8	70
2050-080	2.5	5	6	10	80
2060-090	3	6	6	12	90
2080-100	4	8	8	14	100
2100-100	5	10	10	18	100
2120-110	6	12	12	22	110



PRE4000 (Radius)



ØD	Tolerance
~Ø5.9	0.00~-0.015
Ø6.0~	0.00~-0.025



(mm)

Designation		ØD	Ød	ℓ	L	r
PRE 4	4030-060-R01	3	6	8	60	0.1
	4030-060-R02	3	6	8	60	0.2
	4030-060-R03	3	6	8	60	0.3
	4030-060-R05	3	6	8	60	0.5
	4040-070-R01	4	6	10	70	0.1
	4040-070-R02	4	6	10	70	0.2
	4040-070-R03	4	6	10	70	0.3
	4040-070-R05	4	6	10	70	0.5
	4040-070-R10	4	6	10	70	1
	4060-090-R02	6	6	15	90	0.2
	4060-090-R03	6	6	15	90	0.3
	4060-090-R05	6	6	15	90	0.5
	4060-090-R10	6	6	15	90	1
	4080-100-R02	8	8	20	100	0.2
	4080-100-R03	8	8	20	100	0.3
	4080-100-R05	8	8	20	100	0.5
	4080-100-R10	8	8	20	100	1
	4100-100-R03	10	10	25	100	0.3
	4100-100-R05	10	10	25	100	0.5
	4100-100-R10	10	10	25	100	1
	4120-110-R03	12	12	30	110	0.3
	4120-110-R05	12	12	30	110	0.5
	4120-110-R10	12	12	30	110	1

F Technical Information for V Endmill

Improved productivity with effective machining due to less vibration

V Endmill

Variable Endmill

- Irregular helix angle
- Irregular indexing angle

* Irregular flute spacing = Decreased vibration

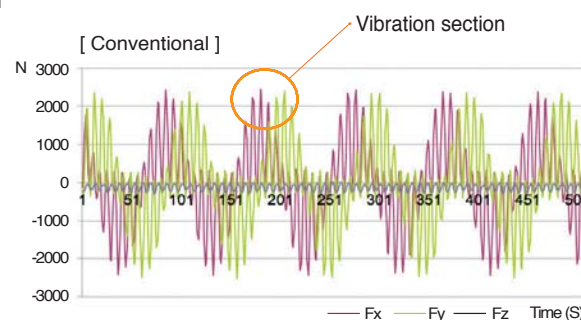
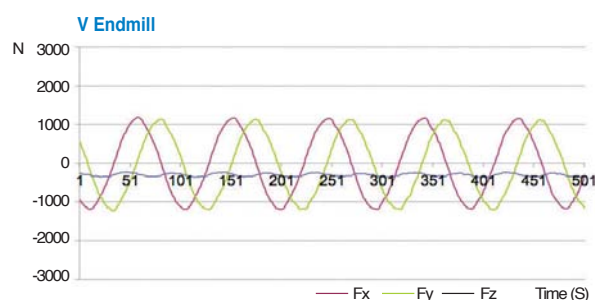


Features

- 30% increased cutting speed (vc) and feed rate (vf) to boost productivity
- High quality machining available thanks to minimized tool vibrations and excellent surface finish

Performance (Vibration test)

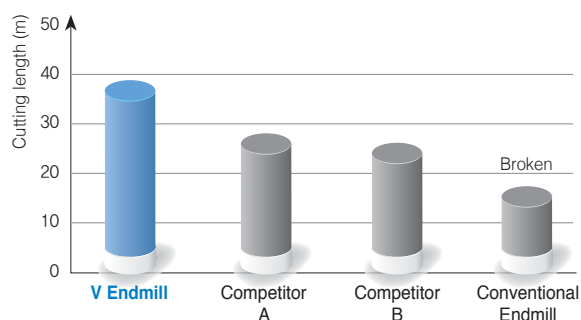
- **Workpiece** SCM440
- **Cutting condition** D = Ø8.0, n (m/min) = 3183, vc (m/min) = 80, vf (mm/min) = 713, fz (mm/t) = 0.055, ap (mm) = 8.0, ae (mm) = 8, Dry
- **Tools** V Endmill (VFE4080-060) Conventional endmill



Performance (Surface finish)

- **Workpiece** STS304
- **Cutting condition** D = Ø8.0, n (min⁻¹) = 3979, vc (m/min) = 100, vf (mm/min) = 796, fz (mm/t) = 0.05, ap (mm) = 12, ae (mm) = 0.8, Dry
- **Tools** VFE4080-060

Edge			
Surface finish			
Division	V Endmill	Competitor A Irregular flute spacing Endmill	Competitor B Irregular flute spacing Endmill



Application examples

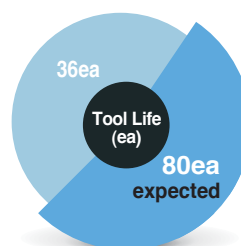
- **Workpiece** SNCM439 (HRC 43~45)
- **Cutting condition** D = Ø8.0, n (m/min) = 6000, vc (m/min) = 150, vf (mm/min) = 600, fz (mm/t) = 0.025, ap (mm) = 7, ae (mm) = 0.8, Wet (Water-soluble)
- **Tools** VFE4080-060



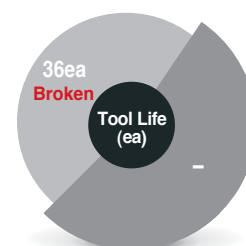
V Endmill



Conventional Endmill



V Endmill(VFE4080)



Conventional Endmill

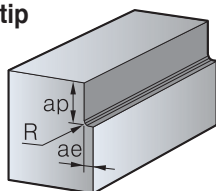


Cutting condition

Shouldering

Diameter (ØD)	Alloy & Carbon steel, HRC25 or less (SM, SCM)				Mold steel, HRC35~45 (STS, KP4M)			
	R.P.M (min ⁻¹)	Feed (mm/min)	ap (mm)	ae (mm)	R.P.M (min ⁻¹)	Feed (mm/min)	ap (mm)	ae (mm)
2.5	15,915	1,241	3.8	0.7	12,732	891	0.3	0.3
3.0	13,263	1,241	4.5	0.8	10,610	891	0.3	0.3
3.5	11,368	1,241	5.3	0.9	9,095	891	0.4	0.4
4.0	9,947	1,241	6.0	1.1	7,958	891	0.4	0.4
5.0	7,958	1,241	7.5	1.4	6,366	891	0.5	0.5
6.0	6,631	1,241	9.0	1.6	5,305	891	0.6	0.6
7.0	5,684	1,241	10.5	1.9	4,547	891	0.7	0.7
8.0	4,974	1,194	12.0	2.2	3,979	891	0.8	0.8
9.0	4,421	1,194	13.5	2.4	3,537	891	0.9	0.9
10.0	3,979	1,194	15.0	2.7	3,183	891	1.0	1.0
12.0	3,316	1,194	18.0	3.2	2,653	891	1.2	1.2
14.0	2,842	1,194	21.0	3.8	2,274	891	1.4	1.4
16.0	2,487	1,194	24.0	4.3	1,989	891	1.6	1.6

Application tip



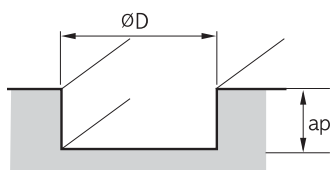
※ Cutting condition by overhang

1. Standard overhang: Follow cutting condition above
2. Long overhang: When the overhang is increased by 10mm, decrease feed 5% & ae 5%

Slotting

Diameter (ØD)	Alloy & Carbon steel, HRC25 or less (SM, SCM)			Mold steel, HRC35~45 (STS, KP4M)		
	R.P.M (min ⁻¹)	Feed (mm/min)	ap (mm)	R.P.M (min ⁻¹)	Feed (mm/min)	ap (mm)
2.5	15,915	1,035	2.8	12,732	700	2.5
3.0	13,263	1,035	3.3	10,610	700	3.0
3.5	11,268	1,035	3.9	9,095	700	3.5
4.0	9,947	1,035	4.4	7,958	700	4.0
5.0	7,958	1,035	5.5	6,366	700	5.0
6.0	6,631	1,035	6.6	5,305	700	6.0
7.0	5,687	1,035	7.7	4,549	700	7.0
8.0	4,974	1,035	8.8	3,979	700	8.0
9.0	4,421	1,035	9.9	3,537	700	9.0
10.0	3,979	1,035	11.0	3,183	700	10.0
12.0	3,316	1,035	13.2	2,653	700	12.0
14.0	2,842	1,035	15.4	2,274	700	14.0
16.0	2,487	1,035	17.6	1,989	700	16.0

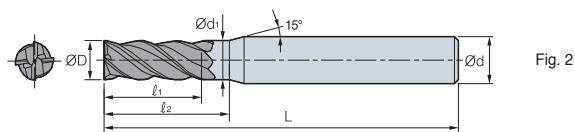
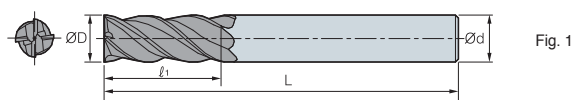
Application tip



※ Cutting condition by overhang

1. Standard overhang: Follow cutting condition above
2. Long overhang: When the overhang is increased by 10mm, decrease feed 5% & ae 5%

VFE4000 (Flat)



ØD	Tolerance
Ø2.5~Ø9	0.00~ -0.02
Ø10~Ø16	0.00~ -0.03



(mm)

Designation		ØD	Ød	d ₁	ℓ ₁	ℓ ₂	L	Fig.
 VFE 4	4025-045	2.5	6.0	2.48	6.0	8.0	45	2
	4030-050	3.0	6.0	2.98	7.0	9.5	50	2
	4035-050	3.5	6.0	3.48	8.0	11.0	50	2
	4040-050	4.0	6.0	3.98	9.0	12.0	50	2
	4050-050	5.0	6.0	4.98	12.0	16.0	50	2
	4060-050	6.0	6.0	-	14.0	-	50	1
	4070-060	7.0	8.0	6.97	16.0	21.0	60	2
	4080-060	8.0	8.0	-	19.0	-	60	1
	4090-070	9.0	10.0	8.97	20.0	27.0	70	2
	4100-075	10.0	10.0	-	23.0	-	75	1
	4120-080	12.0	12.0	-	27.0	-	80	1
	4140-085	14.0	14.0	-	31.0	-	85	1
	4160-090	16.0	16.0	-	36.0	-	90	1



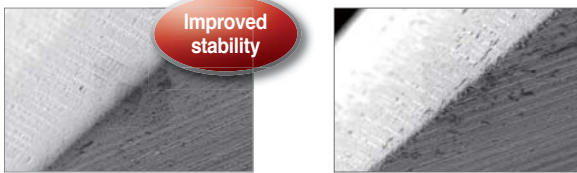
Endmill for general cutting

Z Endmill new

- Endmill for general cutting of various workpieces under HRC45 (carbon steel, alloy steel, cast iron, pre-hardened steel, etc.)
- New shape and coating improves performance and tool life
- Optimized blade design for less chipping and stable machining

Features

- New grade (PC315E) - Fine substrate and lubricative coating guarantee excellent performance at high speed and high temperature
- Special edge treatment - Special cutting-edge design was applied for less chipping and longer tool life
- High accuracy with tolerance-h5 - High quality production system enables tolerance-h5 throughout the whole series

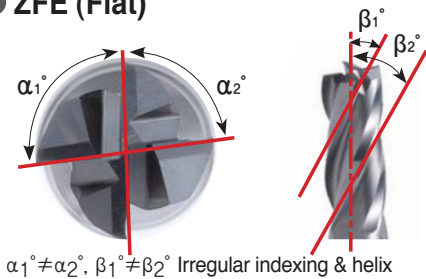


After special edge treatment

before

Improved stability

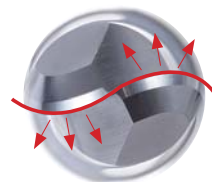
ZFE (Flat)



$\alpha_1^\circ \neq \alpha_2^\circ$, $\beta_1^\circ \neq \beta_2^\circ$ Irregular indexing & helix

- Irregular indexing & helix prevent chattering and improve surface

ZBE (Ball)



S shape of ball

Cutting load is dispersed

- The S shape of ball disperses cutting loads
- The tolerance of ball R is under ± 0.005 mm

Application examples

- **Workpiece** Carbon steel [1045(AISI)/C45(DIN)/S45C(JIS), HRC20]
- **Cutting condition** D = $\varnothing 8.0$, n (min^{-1}) = 7,165, vc (m/min) = 180, vf (mm/min) = 1.433, fz (mm/t) = 0.05, ap (mm) = 8, ae (mm) = 0.8, dry
- **Tools** ZFE4080-070



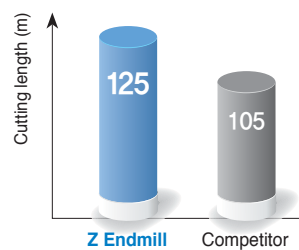
Edge in good shape

Z Endmill



Competitor

Test result



1.2 times increased

- Cutting edge treatment for less chipping

- **Workpiece** Carbon steel [1045(AISI)/C45(DIN)/S45C(JIS), HRC20]
- **Cutting condition** D = $\varnothing 8.0$, n (min^{-1}) = 5,175, vc (m/min) = 130, vf (mm/min) = 1.035, fz (mm/t) = 0.1, ap (mm) = 0.5, ae (mm) = 1.6, dry
- **Tools** ZFE2080-100



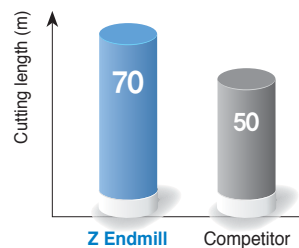
Excellent wear resistance

Z Endmill



Competitor

Test result



1.3 times increased

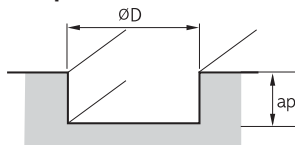
- New grade improves wear resistance

F Technical Information for Z Endmill

Recommended cutting conditions (ZFE2000/ZSFE2000 flat)

Workpiece Condition Diameter (Ø)	Alloy steel & carbon steel (under HRC30)		Pre-hardened steel (HRC30~45)		Stainless steel	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
1	19,745	175	13,057	100	10,500	70
2	11,560	190	7,560	120	6,300	90
3	8,920	210	5,560	140	4,620	120
4	7,560	300	4,620	180	3,880	150
5	6,300	320	3,780	190	3,160	160
6	5,560	350	3,360	220	2,840	180
8	4,200	380	2,520	200	2,100	180
10	3,260	330	2,000	160	1,680	160
12	2,740	280	1,680	130	1,360	130
16	2,200	220	1,360	110	1,060	110

Application tip



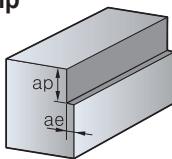
- Slotting depth (ap)
 - $D \leq \varnothing 3$ (ap = 0.2D)
 - $D > \varnothing 3$ (ap = 0.5D)

* Workpiece should be clamped rigidly. In case of vibration, reduce R.P.M and feed rate by the same ratio

Recommended cutting conditions (ZFE4000/ZSFE4000 flat)

Workpiece Condition Diameter (Ø)	Alloy steel & carbon steel (under HRC30)		Pre-hardened steel (HRC30~45)		Stainless steel	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
2	11,560	280	7,560	170	6,300	140
3	8,920	320	5,560	200	4,620	170
4	7,560	570	4,620	350	3,880	280
5	6,300	600	3,780	360	3,160	300
6	5,560	660	3,360	410	2,840	330
8	4,200	710	2,520	380	2,100	350
10	3,260	610	2,000	300	1,680	300
12	2,740	520	1,680	250	1,360	240
16	2,200	410	1,360	200	1,100	200

Application tip



- Shouldering depth (ap) and radial depth (ae)
 - ap = 1.0D
 - ae = 0.05D

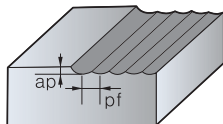
* Workpiece should be clamped rigidly. In case of vibration, reduce R.P.M and feed rate by the same ratio



Recommended cutting conditions (ZBE2000 ball)

Workpiece Condition Diameter (Ø)	Alloy steel & carbon steel (under HRC30)		Pre-hardened steel (HRC30~45)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
1	30,000	2,880	30,000	2,520
1.2	30,000	3,060	28,800	2,580
1.5	30,000	3,240	28,800	2,700
2	29,820	3,420	28,680	2,880
3	19,860	3,600	19,080	3,180
4	14,940	3,600	14,340	3,180
5	11,160	3,480	10,680	2,940
6	8,340	2,910	8,040	2,460
8	6,660	2,520	6,420	2,100
10	5,580	2,220	5,340	1,860
12	4,170	1,770	4,008	1,500

Application tip

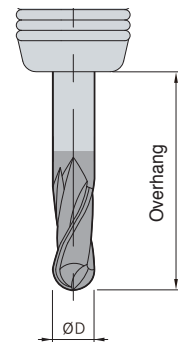


- $ap = 0.03D$
- $pf = 0.05D$

* Workpiece should be clamped rigidly. In case of vibration, reduce R.P.M and feed rate by the same ratio

Cutting condition by overhang

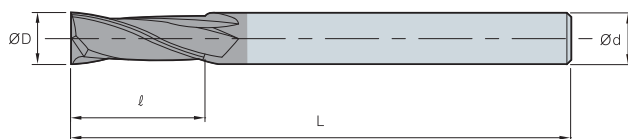
- Cutting conditions of the shank taper type in case of being clamped at neck
 - When the overhang is increased by 1D, decrease R.P.M and feed 10%
- In case of the straight type adjust conditions according to the overhang
 - Ex: When the overhang is 3D and is increased by 1D, decrease R.P.M and feed 10%



Notice

- Cutting conditions are up to the machine's condition and the shape of cutting
- Use cutting fluid that is proper to the workpiece and produces few temperature reactions

ZFE2000 (Flat)



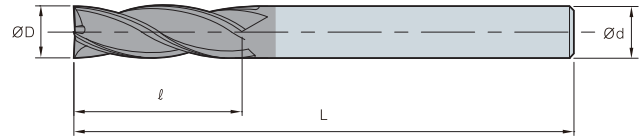
ØD	Tolerance
~Ø5.9	0.00~-0.015
Ø6.0~	0.00~-0.025



(mm)

Designation		ØD	Ød	ℓ	L
ZFE 2	2010-050-S4	1	4	2.5	50
	2010-050-S6	1	6	2.5	50
	2012-050-S4	1.2	4	3	50
	2012-050-S6	1.2	6	3	50
	2015-050-S4	1.5	4	4	50
	2015-050-S6	1.5	6	4	50
	2020-050-S4	2	4	6	50
	2020-050-S6	2	6	6	50
	2025-050-S4	2.5	4	7.5	50
	2025-050-S6	2.5	6	7.5	50
	2030-050-S4	3	4	9	50
	2030-050-S6	3	6	9	50
	2035-050	3.5	6	10	50
	2040-050-S4	4	4	11	50
	2040-050-S6	4	6	11	50
	2045-050	4.5	6	14	50
	2050-060	5	6	15	60
	2055-060	5.5	6	15	60
	2060-060	6	6	15	60
	2065-060	6.5	8	18	60
	2070-060	7	8	20	60
	2075-060	7.5	8	20	60
	2080-070	8	8	20	70
	2085-070	8.5	10	22	70
	2090-070	9	10	22	70
	2095-070	9.5	10	24	70
	2100-075	10	10	25	75
	2120-080	12	12	30	80
	2140-100	14	14	35	100
	2160-100	16	16	40	100



ZFE4000 (Flat)

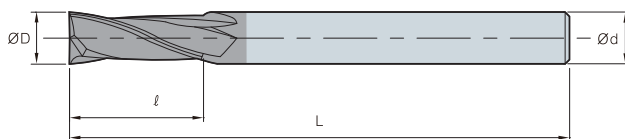
ØD	Tolerance
~Ø5.9	0.00~ -0.015
Ø6.0~	0.00~ -0.025



(mm)

Designation		ØD	Ød	ℓ	L
ZFE 	4010-050-S4	1	4	2.5	50
	4010-050-S6	1	6	2.5	50
	4012-050-S4	1.2	4	3	50
	4012-050-S6	1.2	6	3	50
	4015-050-S4	1.5	4	4	50
	4015-050-S6	1.5	6	4	50
	4020-050-S4	2	4	6	50
	4020-050-S6	2	6	6	50
	4025-050-S4	2.5	4	7.5	50
	4025-050-S6	2.5	6	7.5	50
	4030-050-S4	3	4	9	50
	4030-050-S6	3	6	9	50
	4035-050	3.5	6	10	50
	4040-050-S4	4	4	11	50
	4040-050-S6	4	6	11	50
	4045-050	4.5	6	14	50
	4050-060	5	6	15	60
	4055-060	5.5	6	15	60
	4060-060	6	6	15	60
	4065-060	6.5	8	18	60
	4070-060	7	8	20	60
	4075-060	7.5	8	20	60
	4080-070	8	8	20	70
	4085-070	8.5	10	22	70
	4090-070	9	10	22	70
	4095-070	9.5	10	24	70
	4100-075	10	10	25	75
	4120-080	12	12	30	80
	4140-100	14	14	35	100
	4160-100	16	16	40	100

ZSFE2000/4000 (Short flat)



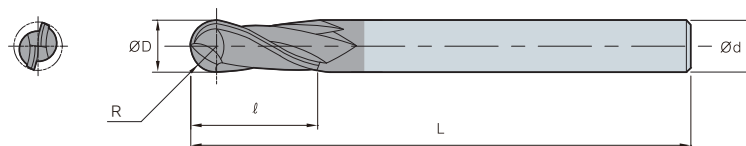
ØD	Tolerance
~Ø5.9	0.00~ -0.015
Ø6.0~	0.00~ -0.025



(mm)

	Designation	ØD	Ød	ℓ	L
ZSFE 2	2010-040-S4	1	4	1.5	40
	2010-040-S6	1	6	1.5	40
	2012-040-S4	1.2	4	1.5	40
	2012-040-S6	1.2	6	1.5	40
	2015-040-S4	1.5	4	2.2	40
	2015-040-S6	1.5	6	2.2	40
	2020-040-S4	2	4	3	40
	2020-040-S6	2	6	3	40
	2025-040-S4	2.5	4	4	40
	2025-040-S6	2.5	6	4	40
	2030-045-S4	3	4	4.5	45
	2030-045-S6	3	6	4.5	45
	2040-045-S4	4	4	6	45
	2040-045-S6	4	6	6	45
	2060-050	6	6	9	50
	2080-060	8	8	12	60
ZSFE 4	2100-065	10	10	15	65
	2120-070	12	12	18	70
	4010-040-S4	1	4	1.5	40
	4010-040-S6	1	6	1.5	40
	4012-040-S4	1.2	4	1.5	40
	4012-040-S6	1.2	6	1.5	40
	4015-040-S4	1.5	4	2.2	40
	4015-040-S6	1.5	6	2.2	40
	4020-040-S4	2	4	3	40
	4020-040-S6	2	6	3	40
	4025-040-S4	2.5	4	4	40
	4025-040-S6	2.5	6	4	40
	4030-045-S4	3	4	4.5	45
	4030-045-S6	3	6	4.5	45
	4040-045-S4	4	4	6	45
	4040-045-S6	4	6	6	45
	4060-050	6	6	9	50
	4080-060	8	8	12	60
	4100-065	10	10	15	65
	4120-070	12	12	18	70



ZBE2000 (Ball)

ØD	Tolerance
~Ø5.9	0.00~-0.015
Ø6.0~	0.00~-0.025



(mm)

Designation	R	ØD	Ød	ℓ	L
ZBE					
2 2010-050-S4	0.5	1	4	2.5	50
2010-050-S6	0.5	1	6	2.5	50
2012-050-S4	0.6	1.2	4	3	50
2012-050-S6	0.6	1.2	6	3	50
2015-050-S4	0.75	1.5	4	4	50
2015-050-S6	0.75	1.5	6	4	50
2020-050-S4	1	2	4	5	50
2020-050-S6	1	2	6	5	50
2025-060-S4	1.25	2.5	4	6	60
2025-060-S6	1.25	2.5	6	6	60
2030-060-S4	1.5	3	4	8	60
2030-060-S6	1.5	3	6	8	60
2035-070	1.75	3.5	6	8	70
2040-070-S4	2	4	4	8	70
2040-070-S6	2	4	6	8	70
2045-080	2.25	4.5	6	9	80
2050-080	2.5	5	6	10	80
2055-090	2.75	5.5	6	11	90
2060-090	3	6	6	12	90
2065-090	3.25	6.5	8	13	90
2070-090	3.5	7	8	14	90
2080-100	4	8	8	14	100
2085-100	4.25	8.5	10	16	100
2090-100	4.5	9	10	18	100
2100-100	5	10	10	18	100
2120-110	6	12	12	22	110

F Technical Information for F Endmill

High efficiency and high feed machining

F Endmill

Feed-up Endmill

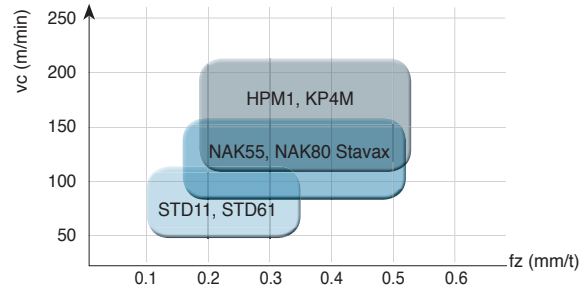
- Improved productivity and shortened working time thanks to high feed capability
- Reduced costs thanks to the highly efficient machining process

Feature



- Wider chip pocket area highly efficient operation
- High feed machining possible by dispersing cutting forces

Application by workpiece

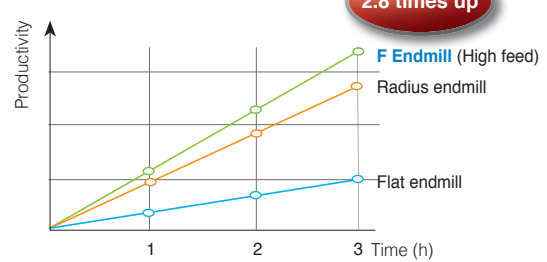


Productivity example

Type	Speed (vc)	Feed (fz)	D.O.C		Machining volume (mm ³ /min)
			ap	ae	
F-Endmill (High feed)	180	0.30	0.5	5.0	135,000
Radius Endmill	200	0.09	1.0	5.0	90,000
Flat Endmill	120	0.05	8.0	0.2	48,000

Higher productivity by feed increase. 2.8 times

Productivity comparison



Programing information

Ramping	Ramping angle	Feed
	1°	100%
	2°	80%
	3°	60%
	4°	50%

Helical Ramping	Diameter (ØD)	Min. diameter	Max. diameter
	6	7.8	12
	8	10.2	16
	10	12.4	20
	12	14.9	24

* ØDc: Feed (Tool center) * ØDh: Machining area

CAM Ramping	Diameter (ØD)	Endmill-R	CAM-Radius	Un-cut part
	6	0.5	0.7	0.21
	8	0.5	0.8	0.32
	10	1.0	1.3	0.36
	12	1.2	1.6	1.45



F

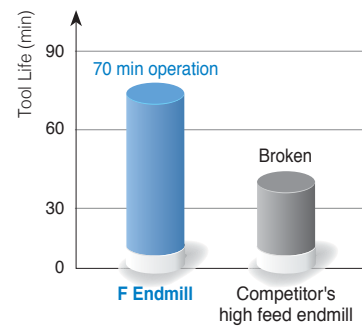
Endmills

Application examples

- Workpiece STD61+SKT (HRC45~50)
- Cutting condition $D = \varnothing 12$, n (min⁻¹) = 4,000, vc (m/min) = 150.8, vf (mm/min) = 4,000, fz (mm/t) = 0.25, ap (mm) = 3.6, ae (mm) = 0.6, dry
- Tools FME4120-075-R12



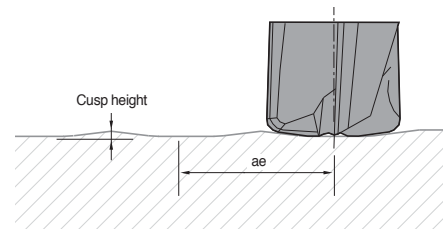
Test result



Cutting condition

Cusp height by radial depth of cut

Diameter (ØD)	Radial depth ae (mm)					
	0.1XD	0.2XD	0.3XD	0.4XD	0.5XD	0.6XD
6	0	0	0	0.02	0.06	0.11
8	0	0	0	0.04	0.10	0.15
10	0	0	0.01	0.07	0.14	0.21
12	0	0	0.01	0.08	0.17	0.25



Medium cut

Diameter (ØD)	Mold steel Hrc35~45 (HPM1, KP4M)				Mold steel Hrc45~55 (NAK55, NAK80, STAVAX)				Heat treated Hrc55 (SKD11, STD61)			
	RPM n (min ⁻¹)	Feed (mm/min)	ap (mm)	ae (mm)	RPM n (min ⁻¹)	Feed (mm/min)	ap (mm)	ae (mm)	RPM n (min ⁻¹)	Feed (mm/min)	ap (mm)	ae (mm)
6	11,600	11,200	0.24	1.6	9,000	7,570	0.21	1.6	5,800	3,500	0.18	1.6
8	8,700		0.32	2.2	6,700		0.28	2.2	4,300		0.24	2.2
10	7,000		0.40	2.7	5,400		0.35	2.7	3,500		0.30	2.7
12	5,800		0.48	3.3	4,500		0.42	3.3	2,900		0.36	3.3

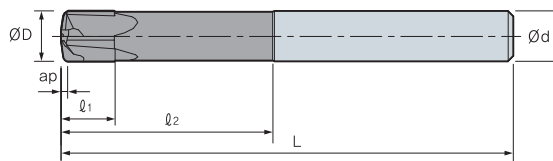
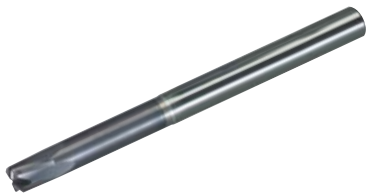
Roughing cut

Diameter (ØD)	Mold steel Hrc35~45 (HPM1, KP4M)				Mold steel Hrc45~55 (NAK55, NAK80, STAVAX)				Heat treated Hrc55 (SKD11, STD61)			
	RPM n (min ⁻¹)	Feed (mm/min)	ap (mm)	ae (mm)	RPM n (min ⁻¹)	Feed (mm/min)	ap (mm)	ae (mm)	RPM n (min ⁻¹)	Feed (mm/min)	ap (mm)	ae (mm)
6	8,488	9,167	0.27	3.0	6,366	6,112	0.24	3.0	4,244	2,546	0.21	3.0
8	6,366		0.36	4.0	4,775		0.32	4.0	3,183		0.28	4.0
10	5,093		0.45	5.0	3,820		0.40	5.0	2,546		0.35	5.0
12	4,244		0.54	6.0	3,183		0.48	6.0	2,122		0.42	6.0

* Cutting condition by overhang

- Standard overhang: Follow cutting conditions above
- Long type: Apply 80% feed & 80% ae
- Long overhang: When the overhang is increased by 10mm, decrease feed 5% & ae 5%

FME4000 (Standard)



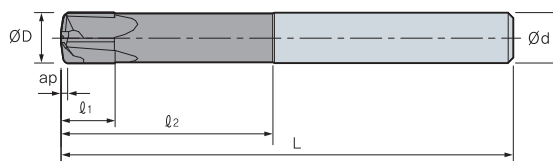
ØD	Tolerance
Ø6~Ø12	-0.01~-0.03



(mm)

Designation		R	ØD	Ød	ℓ ₁	ℓ ₂	L	Max. ap (mm)	CAM-Radius
 FME 4	4060-050-R05	0.5	6	6	4.5	18	50	0.35	0.7
	4080-060-R05	0.5	8	8	6	24	60	0.45	0.8
	4100-070-R10	1.0	10	10	7.5	30	70	0.65	1.3
	4120-075-R12	1.2	12	12	9	36	75	0.78	1.6

FMLE4000 (Long)



ØD	Tolerance
Ø6~Ø12	-0.01~-0.03



(mm)

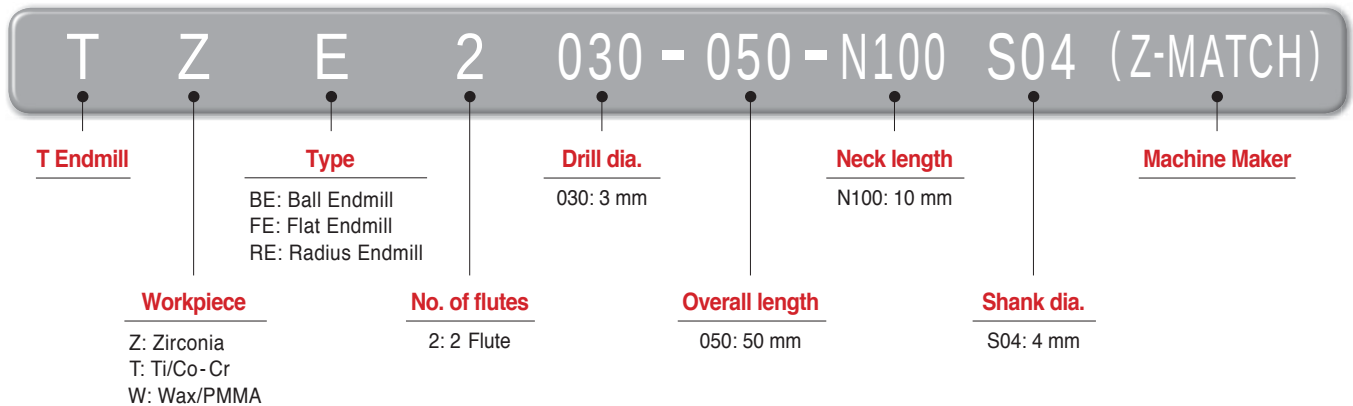
Designation		R	ØD	Ød	ℓ ₁	ℓ ₂	L	Max. ap (mm)	CAM-Radius
FMLE 4	4060-090-R05	0.5	6	6	4.5	30	90	0.35	0.7
	4080-090-R05	0.5	8	8	6	40	90	0.45	0.8
	4100-100-R10	1.0	10	10	7.5	50	100	0.65	1.3
	4120-110-R12	1.2	12	12	9	60	110	0.78	1.6

Endmill for machining dental prostheses

T Endmill new

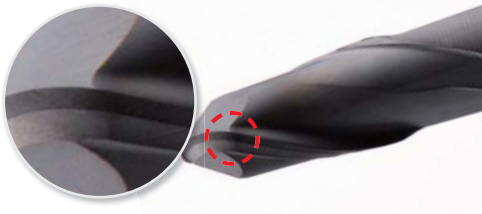
- For machining dental prostheses made of zirconia, titanium, Co-Cr, wax, PMMA, etc
- Optimized cutting performance by matching a proper grade with each type of materials
- Inhibited unevenness and excellent finish in machined surfaces due to the optimized cutting-edge design
- Specialized tool shape for each machine type

Code system



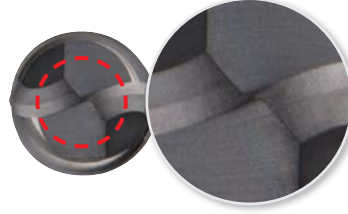
Features

- A dedicated tool for each machine - Meets marketplace demands
- A specialized grade for each workpiece - Provides optimized performance for various materials of implants
- Optimized cutting-edge design - Enables excellent machinability



Tangential cutting-edge shape

- One-Pass Grinding applied
- Inhibited unevenness and excellent finish in machined surfaces

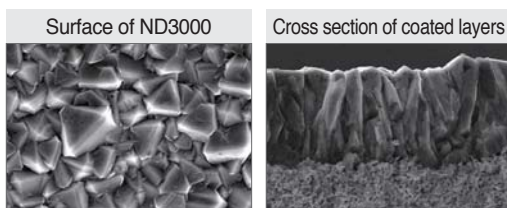


Center-Matched ball shape

- High Center-Matched shape ensures relief angle at the ball point
- Cutting edges of the ball point shape provide excellent wear resistance and cutting performance

Grade solution for zirconia

- **Development of ND3000 (Diamond-coated grade)**
 - High hardness diamond coating that is excellent in machining graphite and ceramic
 - Optimized for high speed and medium duty cutting thanks to its excellent grip to coated layers

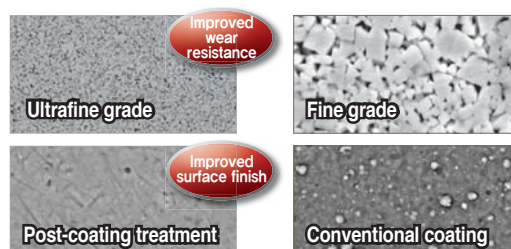


High hardness diamond coating (Hv 10,000) provides excellent wear resistance

Specialized grade for Zirconia provides excellent adhesion

Grade solution for titanium

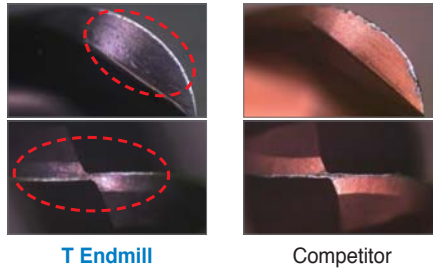
- **Development of PC2510 (Coated grade for high hardened steel)**
 - Post-coating treatment was applied to improve surface finish
 - A grade optimized for interrupted machining of high hardness steels and wet treatment accompanying high thermal shock. Its ultrafine substrate features high toughness which allows stable performance



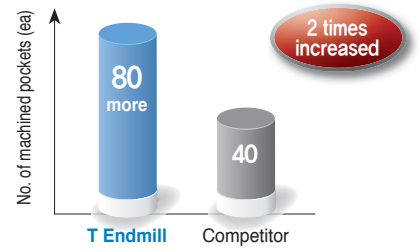
F Technical Information for T Endmill

Performance evaluation

- **Workpiece** Co-Cr
- **Cutting conditions**
 - vc (m/min) = 150, Use
 - fz (mm/t) = 0.08
 - ap (mm) = 0.13
 - ae (mm) = 0.7, wet
- **Tools** TTBE2030-050



Test result



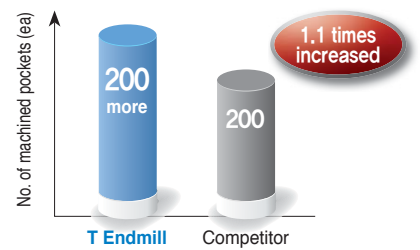
Excellent resistance to toughness and wear thanks to the new grade PC2510

Application examples

- **Use** Implant crowns
- **Workpiece** Zirconia
- **Cutting conditions**
 - vc (m/min) = 140
 - fz (mm/t) = 0.05
 - ae (mm) = 0.6, dry
- **Tools** TZBE2020-044-N200S03 (DOF)



Test result



Recommended cutting conditions (Titanium & Co-Cr)

Diameter (Ø)	Application	ap (mm)	ae (mm)	n (min ⁻¹)	vf (mm/min)
3.0	Roughing	0.12	0.7	10,500	1,150
2.5	Medium	0.08	0.53	11,500	850
2.0	Medium	0.08	0.42	14,500	850
1.5	Finishing	0.04	0.32	19,000	850
1.0	Finishing	0.02	0.07	28,500	850
0.6	Finishing	0.02	0.07	28,500	850

Recommended cutting conditions for zirconia

Diameter (Ø)	Application	ap (mm)	ae (mm)	n (min ⁻¹)	vf (mm/min)
3.0	Roughing	0.5	1.5	23,500	1,600
2.5	Medium	0.3	1.25	28,000	1,200
2.0	Finishing	0.3	1.0	35,000	1,200
1.0	Finishing	0.1	0.2	38,500	1,050
0.6	Finishing	0.1	0.2	63,500	630

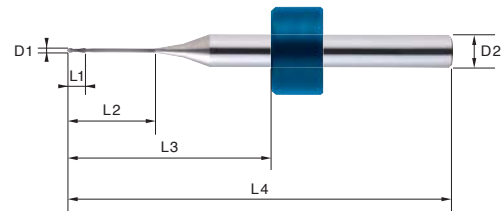


Special T Endmill order form

- Stop rings and other tool resources can be made to order

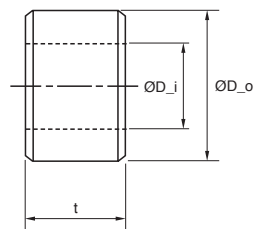
[Data sheet]

Type of machine	
Workpiece	
Dental material	
Cutting diameter (D1)	
Shank diameter (D2)	
Cutting length (L1)	
Neck length (L2)	
Stop ring position (L3)	
Overall length (L4)	
Stop ring shape	

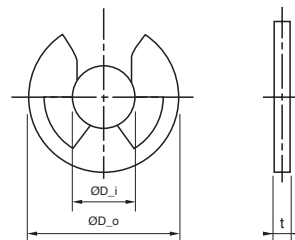


* Should you make a special order, please complete this form and send it to an adjacent KORLOY sales office

[Stop ring specification]



< Plastic ring >



< E type ring >

(mm)

Type	Stop ring			Shank diameter		
	ØD_o	ØD_i	t	Ø3	Ø4	Ø6
Plastic ring	Ø7.55	Ø3	4.45	●		
	Ø7.7	Ø4	5.0		●	
	Ø10.5	Ø6	6.5			●
E type ring	Ø6.0	Ø2.5	0.4	●		

* Stop ring can be made to order when specified sizes are send to an adjacent KORLOY sales office

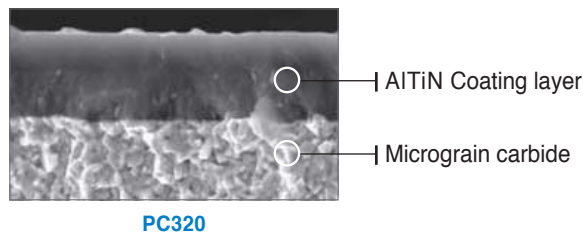


F Technical Information for I⁺ Endmill

Stable performance guaranteed for workpiece workpieces under HRC45

I⁺ Endmill

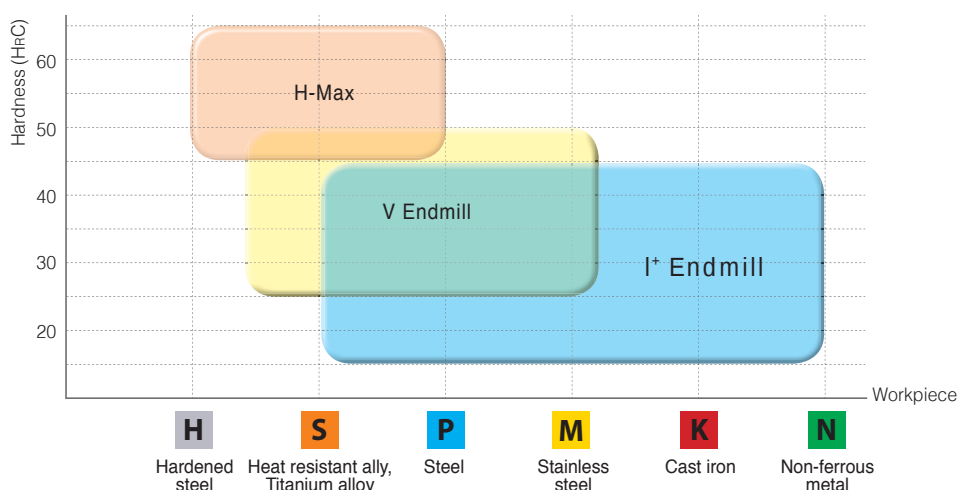
- Tough substrate & wear-resisting coating technology applied
- Wide application range in general use
 - Stable performance guaranteed for workpiece which is under 45 HRC
- Saving cost by higher productivity



Product line-up

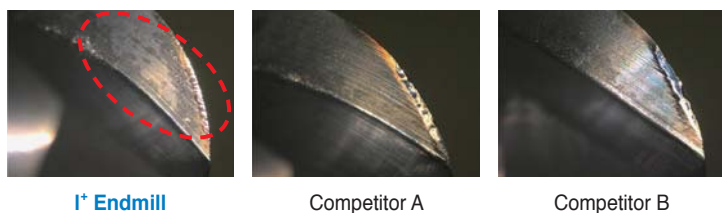
- IPBE: I Plus Ball Endmill (Ø1~Ø20)
- IPFE: I Plus Flat Endmill (Ø1~Ø20)
- IPRE: I Plus Radius Endmill (Ø1~Ø12)

Application area

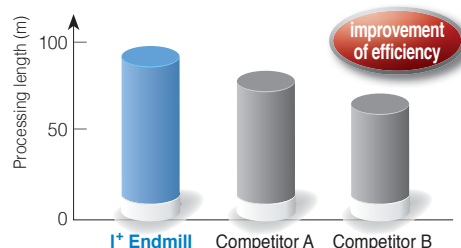


Performance evaluation

- Workpiece SM45C
- Cutting conditions Diameter = Ø8.0, n (min⁻¹) = 5.173, vc (m/min) = 130.0, vf (mm/min) = 1.034, fz (mm/t) = 0.1, ap (mm) = 0.5, ae (mm) = 1.6, dry
- Tools IPBE2080-060



Test result

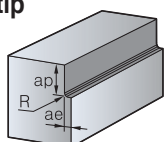


Recommended cutting condition (flat)

■ IPFE2000

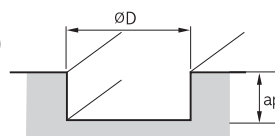
Diameter (ØD)	Carbon steel, Alloy steel~HRC30 (SM50C, SCM, GC250, Cast iron)			Alloy steel, High speed steel HRC30~45 (Pre-hardened steels, STD61, NAK)			Stainless steel (STS304, STS316)		
	R.P.M (min ⁻¹)	Feed (mm/min)		R.P.M (min ⁻¹)	Feed (mm/min)		R.P.M (min ⁻¹)	Feed (mm/min)	
		Shouldering	Slotting		Shouldering	Slotting		Shouldering	Slotting
1.0	30,000	600	480	20,000	400	320	12,600	300	180
1.5	20,000	600	480	14,000	400	320	8,400	300	180
2.0	15,000	600	480	10,000	400	400	6,300	300	180
2.5	12,000	600	480	8,200	400	320	5,100	300	180
3.0	10,000	600	480	7,000	400	320	4,200	300	180
4.0	7,500	600	480	5,200	400	320	3,100	300	180
5.0	6,000	600	480	4,200	400	320	2,500	300	180
6.0	5,000	600	480	3,500	400	320	2,100	300	180
8.0	4,000	520	410	2,800	350	280	1,600	260	150
10.0	3,200	450	360	2,200	300	240	1,300	230	130
12.0	2,700	410	320	1,900	270	210	1,100	210	120
16.0	2,000	240	190	1,400	210	160	840	160	100
20.0	1,600	200	160	1,100	170	130	680	140	80

Application tip



■ Shouldering depth (ap) and radial depth (ae)

- ap: ≤ 1.5 (All dia.)
- ae: ≤ 0.1D (D ≤ Ø3)
≤ 0.2D (D > Ø3)



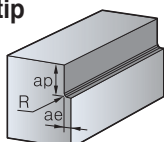
■ Slotting depth (ap)

- ap: ≤ 0.1D (D ≤ Ø2)
≤ 0.2D (D > Ø2)

■ IPFE4000

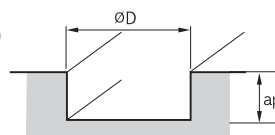
Diameter (ØD)	Carbon steel, Alloy steel ~HRC30 (SM50C, SCM, GC250, Cast iron)			Alloy steel, High speed steel HRC30~45 (Pre-hardened steels, STD61, NAK)			Stainless steel (STS304, STS316)		
	R.P.M (min ⁻¹)	Feed (mm/min)		R.P.M (min ⁻¹)	Feed (mm/min)		R.P.M (min ⁻¹)	Feed (mm/min)	
		Shouldering	Slotting		Shouldering	Slotting		Shouldering	Slotting
1.0	30,000	900	720	20,000	600	480	12,600	450	270
1.5	20,000	900	720	14,000	600	480	8,400	450	270
2.0	15,000	900	720	10,000	600	480	6,300	450	270
2.5	12,000	900	720	8,200	600	480	5,100	450	270
3.0	10,000	900	720	7,000	600	480	4,200	450	270
4.0	7,500	900	720	5,200	600	480	3,100	450	270
5.0	6,000	900	720	4,200	600	480	2,500	450	270
6.0	5,000	900	720	3,500	600	480	2,100	450	270
8.0	4,000	780	620	2,800	520	410	1,600	390	230
10.0	3,200	680	540	2,200	450	360	1,300	340	200
12.0	2,700	620	490	1,900	410	320	1,100	310	180
16.0	2,000	360	280	1,400	310	240	840	240	140
20.0	1,600	300	240	1,100	250	200	680	210	120

Application tip



■ Shouldering depth (ap) and radial depth (ae)

- ap: ≤ 1.5 (All dia.)
- ae: ≤ 0.1D (D ≤ Ø3)
≤ 0.2D (D > Ø3)



■ Slotting depth (ap)

- ap: ≤ 0.1D (D ≤ Ø2)
≤ 0.2D (D > Ø2)

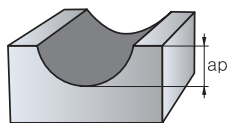
F Technical Information for I⁺ Endmill

Recommended cutting condition (ball)

■ IPBE2000

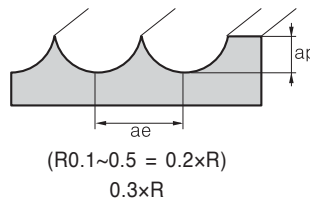
Diameter (ØD)	Carbon steel (SM50C)		Alloy steel (SCM, STD, STS, KP4M, NAK)		Mold steel ~HrC45 (STD61)		Non-ferrous metal (Aluminum)	
	R.P.M (min ⁻¹)	Feed (mm/min)	R.P.M (min ⁻¹)	Feed (mm/min)	R.P.M (min ⁻¹)	Feed (mm/min)	R.P.M (min ⁻¹)	Feed (mm/min)
1.0	40,000	1,200	38,000	1,200	29,000	900	40,000	1,000
1.5	30,000	1,270	25,500	1,100	19,000	700	40,000	1,360
2.0	24,000	1,160	19,000	800	14,300	600	40,000	2,000
2.5	19,000	1,000	15,300	670	11,500	510	38,000	2,400
3.0	16,000	930	13,000	600	9,600	460	32,000	2,400
3.5	13,700	930	11,400	580	8,200	450	27,300	2,400
4.0	12,000	930	10,000	570	7,200	450	24,000	2,400
5.0	9,600	930	8,000	560	5,700	450	19,000	2,400
6.0	8,000	930	6,400	540	4,800	450	16,000	2,400
8.0	6,000	900	4,800	540	3,600	450	12,000	2,400
10.0	4,800	900	3,800	540	2,900	450	9,600	2,300
12.0	4,000	900	3,200	540	2,400	450	8,000	2,100
14.0	3,400	900	2,750	540	2,050	450	6,800	2,000
16.0	3,000	900	2,400	540	1,800	450	6,000	2,000
20.0	2,400	900	1,900	520	1,450	450	4,800	2,000

Application tip



■ Slotting depth (ap)

- ap: 0.1×R (~45HRC)
- 0.08×R (~50HRC)



■ Shouldering depth (ap) and radial depth (ae)

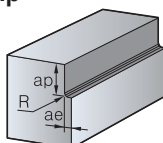
- ~0.16×R R ≤ 0.3 (~45HRC)
- ~0.25×R R ≤ 3 (~45HRC)
- ~0.17×R R ≤ 4 (~45HRC)
- ~0.05×R (~50HRC)

Recommended cutting condition (Radius)

■ IPRE2000

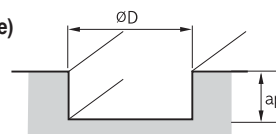
Diameter (ØD)	Carbon steel, Alloy steel ~HrC30 (SM50C, SCM, GC250, Cast iron)			Alloy steel, High speed steel HrC30~45 (Pre-hardened steels, STD61, NAK)			Stainless steel (STS304, STS316)		
	R.P.M (min ⁻¹)	Feed (mm/min)		R.P.M (min ⁻¹)	Feed (mm/min)		R.P.M (min ⁻¹)	Feed (mm/min)	
		Shouldering	Slotting		Shouldering	Slotting		Shouldering	Slotting
2.0	11,000	180	180	7,200	110	110	6,000	90	90
3.0	8,500	200	160	5,300	130	100	4,400	110	66
4.0	7,200	360	290	4,400	220	180	3,000	180	110
5.0	6,000	380	300	3,600	230	180	2,400	190	110
6.0	5,300	420	340	3,200	240	190	2,200	210	130
8.0	4,000	450	360	2,400	240	190	1,600	220	130
10.0	3,200	390	310	1,900	190	150	1,300	190	110
12.0	2,700	330	260	1,600	160	130	1,000	150	90

Application tip



■ Shouldering depth (ap) and radial depth (ae)

- ap: ≤ 1.5D
- ap: ≤ 0.1D

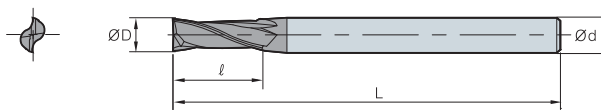


■ Slotting depth (ap)

- ap: ≤ 0.3D



IPFE2000 (Flat)



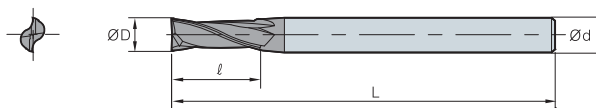
ØD	Tolerance
Ø1~Ø12	0.00~-0.02
Ø12.1~Ø20	0.00~-0.03



(mm)

Designation	ØD	Ød	ℓ	L
IPFE 2	2010-050-S3	1	3	50
	2010-050-S4	1	4	50
	2010-050	1	6	50
	2015-050-S3	1.5	3	50
	2015-050-S4	1.5	4	50
	2015-050	1.5	6	50
	2020-050-S3	2	3	50
	2020-050-S4	2	4	50
	2020-050	2	6	50
	2025-050-S3	2.5	3	50
	2025-050-S4	2.5	4	50
	2025-050	2.5	6	50
	2030-050-S3	3	3	50
	2030-050-S4	3	4	50
	2030-050	3	6	50
	2035-050-S4	3.5	4	50
	2035-050	3.5	6	50
	2040-050-S4	4	4	50
	2040-050	4	6	50
	2045-050	4.5	6	50
	2050-050	5	6	50
	2055-050	5.5	6	50
	2060-050	6	6	50
	2065-060	6.5	8	60
	2070-060	7	8	60
	2075-060	7.5	8	60
	2080-060	8	8	60
	2085-075	8.5	10	75
	2090-075	9	10	75
	2095-075	9.5	10	75
	2100-075	10	10	75
	2105-075	10.5	12	75
	2110-075	11	12	75
	2115-075	11.5	12	75
	2120-075	12	12	75
	2140-100	14	16	100
	2160-100	16	16	100
	2180-100	18	20	100
	2200-100	20	20	100

IPLFE2000 (Long flat)



ØD	Tolerance
Ø1~Ø12	0.00~ -0.02
Ø12.1~Ø20	0.00~ -0.03



Long shank type

(mm)

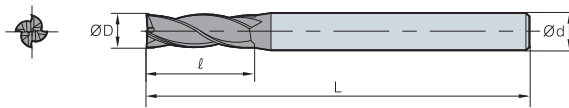
Designation	ØD	Ød	ℓ	L
IPLFE 2	2060-075	6	16	75
	2060-100	6	16	100
	2080-075	8	20	75
	2080-100	8	20	100
	2100-100	10	25	100
	2100-150	10	25	150
	2120-100	12	32	100
	2120-150	12	32	150

Long flute type

(mm)

Designation		ØD	Ød	ℓ	L
IPLFE 2	2010-050-V7S4	1	4	7	50
	2015-050-V9S4	1.5	4	9	50
	2020-050-V12S4	2	4	12	50
	2025-050-V12S4	2.5	4	12	50
	2030-060-V15S6	3	6	15	60
	2035-060-V15S6	3.5	6	15	60
	2040-075-V20S6	4	6	20	75
	2045-075-V20S6	4.5	6	20	75
	2050-075-V25S6	5	6	25	75
	2055-075-V25S6	5.5	6	25	75
	2060-075-V30S6	6	6	30	75
	2070-100-V30S8	7	8	30	100
	2080-100-V40S8	8	8	40	100
	2090-100-V40S10	9	10	40	100
	2100-100-V40S10	10	10	40	100
	2110-100-V40S12	11	12	40	100
	2120-100-V50S12	12	12	50	100
	2140-150-V50S16	14	16	50	150
	2160-150-V60S16	16	16	60	150
	2200-200-V90S20	20	20	90	200



IPFE4000 (Flat)

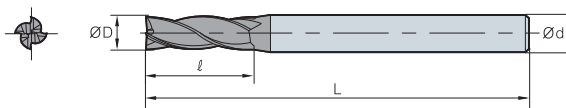
ØD	Tolerance
Ø1~Ø12	0.00~-0.02
Ø12.1~Ø20	0.00~-0.03



(mm)

Designation	ØD	Ød	ℓ	L
IPFE 4	4010-050-S3	1	3	50
	4010-050-S4	1	4	50
	4010-050	1	6	50
	4015-050-S3	1.5	3	50
	4015-050-S4	1.5	4	50
	4015-050	1.5	6	50
	4020-050-S3	2	3	50
	4020-050-S4	2	4	50
	4020-050	2	6	50
	4025-050-S3	2.5	3	50
	4025-050-S4	2.5	4	50
	4025-050	2.5	6	50
	4030-050-S3	3	3	50
	4030-050-S4	3	4	50
	4030-050	3	6	50
	4035-050-S4	3.5	4	50
	4035-050	3.5	6	50
	4040-050-S4	4	4	50
	4040-050	4	6	50
	4045-050	4.5	6	50
	4050-050	5	6	50
	4055-050	5.5	6	50
	4060-050	6	6	50
	4065-060	6.5	8	60
	4070-060	7	8	60
	4075-060	7.5	8	60
	4080-060	8	8	60
	4085-075	8.5	10	75
	4090-075	9	10	75
	4095-075	9.5	10	75
	4100-075	10	10	75
	4105-075	10.5	12	75
	4110-075	11	12	75
	4115-075	11.5	12	75
	4120-075	12	12	75
	4140-100	14	16	100
	4160-100	16	16	100
	4180-100	18	20	100
	4200-100	20	20	100

IPLFE4000 (Long flat)



ØD	Tolerance
Ø1~Ø12	0.00~ -0.02
Ø12.1~Ø20	0.00~ -0.03



Long shank type

(mm)

Designation	ØD	Ød	ℓ	L
IPLFE 4	4060-075	6	16	75
	4060-100	6	16	100
	4080-075	8	20	75
	4080-100	8	20	100
	4100-100	10	30	100
	4100-150	10	30	150
	4120-100	12	32	100
	4120-150	12	32	150

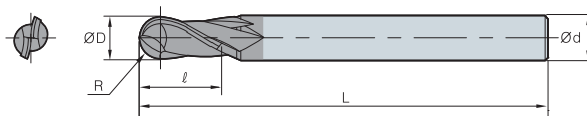
Long flute type

(mm)

Designation	ØD	Ød	ℓ	L
IPLFE 4	4010-050-V6S4	1	4	50
	4015-050-V9S4	1.5	4	50
	4020-050-V12S4	2	4	50
	4025-050-V12S4	2.5	4	50
	4030-060-V15S6	3	6	60
	4035-060-V15S6	3.5	6	60
	4040-075-V20S6	4	6	75
	4045-075-V20S6	4.5	6	75
	4050-075-V25S6	5	6	75
	4055-075-V25S6	5.5	6	75
	4060-075-V30S6	6	6	75
	4070-100-V30S8	7	8	100
	4080-100-V40S8	8	8	100
	4090-100-V40S10	9	10	100
	4100-100-V40S10	10	10	100
	4110-100-V40S12	11	12	100
	4120-100-V50S12	12	12	100
	4140-150-V50S16	14	16	150
	4160-150-V60S16	16	16	150
	4200-200-V90S20	20	20	200



IPBE2000 (Ball)



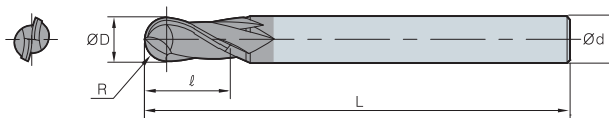
ØD	Tolerance
Ø1~Ø12	0.00~ -0.02
Ø12.1~Ø20	0.00~ -0.03



(mm)

Designation		R	ØD	Ød	ℓ	L
IPBE 2	2010-050-S3	0.5	1	3	2	50
	2010-050-S4	0.5	1	4	2	50
	2010-050	0.5	1	6	2	50
	2015-050-S3	0.75	1.5	3	3	50
	2015-050-S4	0.75	1.5	4	3	50
	2015-050	0.75	1.5	6	3	50
	2020-050-S3	1	2	3	4	50
	2020-050-S4	1	2	4	4	50
	2020-050	1	2	6	4	50
	2025-050-S3	1.25	2.5	3	5	50
	2025-050-S4	1.25	2.5	4	5	50
	2025-050	1.25	2.5	6	5	50
	2030-050-S3	1.5	3	3	6	50
	2030-050-S4	1.5	3	4	6	50
	2030-050	1.5	3	6	6	50
	2035-050-S4	1.75	3.5	4	7	50
	2035-050	1.75	3.5	6	7	50
	2040-050-S4	2	4	4	8	50
	2040-050	2	4	6	8	50
	2045-050	2.25	4.5	6	9	50
	2050-050	2.5	5	6	10	50
	2060-050	3	6	6	12	50
	2070-060	3.5	7	8	14	60
	2080-060	4	8	8	16	60
	2090-075	4.5	9	10	18	75
	2100-075	5	10	10	20	75
	2120-075	6	12	12	24	75
	2140-100	7	14	16	28	100
	2160-100	8	16	16	32	100
	2180-100	9	18	20	36	100
	2200-100	10	20	20	40	100

IPLBE2000 (Long ball)



ØD	Tolerance
Ø1~Ø12	0.00~ -0.02
Ø12.1~Ø16	0.00~ -0.03

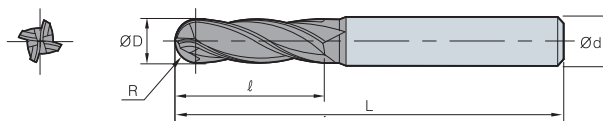


(mm)

Designation		R	ØD	Ød	ℓ	L
IPLBE 2	2010-075	0.5	1	6	2	75
	2010-100	0.5	1	6	2	100
	2015-075	0.75	1.5	6	3	75
	2015-100	0.75	1.5	6	3	100
	2020-075	1	2	6	4	75
	2020-100	1	2	6	4	100
	2025-075	1.25	2.5	6	5	75
	2025-100	1.25	2.5	6	5	100
	2030-075	1.5	3	6	6	75
	2030-100	1.5	3	6	6	100
	2035-100	1.75	3.5	6	7	100
	2040-075	2	4	6	8	75
	2040-100	2	4	6	8	100
	2050-075	2.5	5	6	10	75
	2050-100	2.5	5	6	10	100
	2060-075	3	6	6	12	75
	2060-100	3	6	6	12	100
	2060-150	3	6	6	12	150
	2080-075	4	8	8	16	75
	2080-100	4	8	8	16	100
	2080-150	4	8	8	16	150
	2100-100	5	10	10	20	100
	2100-150	5	10	10	20	150
	2100-200	5	10	10	20	200
	2120-100	6	12	12	24	100
	2120-150	6	12	12	24	150
	2120-200	6	12	12	24	200
	2160-150	8	16	16	32	150
	2160-200	8	16	16	32	200



IPBE4000 (Ball)



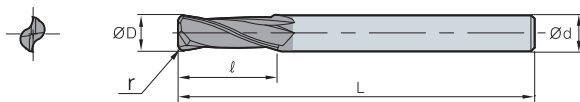
ØD	Tolerance
Ø1~Ø12	0.00~ -0.02
Ø12.1~Ø20	0.00~ -0.03



(mm)

Designation		R	ØD	Ød	ℓ	L
IPBE 	4010-050-S4	0.5	1	4	2	50
	4010-050	0.5	1	6	2	50
	4015-050-S4	0.75	1.5	4	3	50
	4015-050	0.75	1.5	6	3	50
	4020-050-S4	1	2	4	4	50
	4020-050	1	2	6	4	50
	4025-050-S4	1.25	2.5	4	5	50
	4025-050	1.25	2.5	6	5	50
	4030-050-S3	1.5	3	3	6	50
	4030-050-S4	1.5	3	4	6	50
	4030-050	1.5	3	6	6	50
	4035-050-S4	1.75	3.5	4	7	50
	4035-050	1.75	3.5	6	7	50
	4040-050-S4	2	4	4	8	50
	4040-050	2	4	6	8	50
	4045-050	2.25	4.5	6	9	50
	4050-050	2.5	5	6	10	50
	4060-050	3	6	6	12	50
	4070-060	3.5	7	8	14	60
	4080-060	4	8	8	16	60
4090-075	4.5	9	10	18	75	
4100-075	5	10	10	20	75	
4120-075	6	12	12	24	75	
4140-100	7	14	16	28	100	
4160-100	8	16	16	32	100	
4180-100	9	18	20	36	100	
4200-100	10	20	20	40	100	

IPRE2000 (Radius)



ØD	Tolerance
Ø1~Ø12	0.00~ -0.02

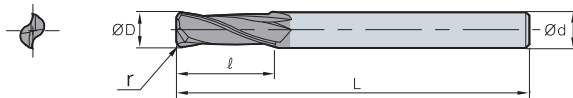


(mm)

Designation		ØD	Ød	ℓ	L	r
IPRE 2	2010-050-R01	1	4	3	50	0.1
	2010-050-R02	1	4	3	50	0.2
	2010-050-R03	1	4	3	50	0.3
	2015-050-R02	1.5	4	4	50	0.2
	2015-050-R03	1.5	4	4	50	0.3
	2020-050-R02	2	4	6	50	0.2
	2020-050-R03	2	4	6	50	0.3
	2020-050-R05	2	4	6	50	0.5
	2025-050-R02	2.5	4	8	50	0.2
	2030-050-R02-S3	3	3	8	50	0.2
	2030-050-R03-S3	3	3	8	50	0.3
	2030-050-R05-S3	3	3	8	50	0.5
	2030-050-R10-S3	3	3	8	50	1
	2030-050-R02	3	4	8	50	0.2
	2030-050-R03	3	4	8	50	0.3
	2030-050-R05	3	4	8	50	0.5
	2030-050-R10	3	4	8	50	1
	2040-050-R02	4	4	10	50	0.2
	2040-050-R03	4	4	10	50	0.3
	2040-050-R05	4	4	10	50	0.5
	2040-050-R10	4	4	10	50	1
	2040-050-R15	4	4	10	50	1.5
	2050-050-R02	5	6	13	50	0.2
	2050-050-R03	5	6	13	50	0.3
	2050-050-R05	5	6	13	50	0.5
	2050-050-R10	5	6	13	50	1
	2060-050-R02	6	6	15	50	0.2
	2060-050-R03	6	6	15	50	0.3
	2060-050-R05	6	6	15	50	0.5
	2060-050-R10	6	6	15	50	1
	2060-050-R15	6	6	15	50	1.5
	2060-050-R20	6	6	15	50	2



IPRE2000 (Radius)



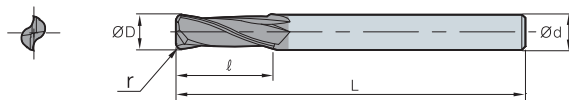
ØD	Tolerance
Ø1~Ø12	0.00~-0.02



(mm)

Designation		ØD	Ød	ℓ	L	r
IPRE	2080-060-R03	8	8	20	60	0.3
	2080-060-R05	8	8	20	60	0.5
	2080-060-R10	8	8	20	60	1
	2080-060-R15	8	8	20	60	1.5
	2080-060-R20	8	8	20	60	2
	2080-060-R25	8	8	20	60	2.5
	2080-060-R30	8	8	20	60	3
	2100-075-R03	10	10	25	75	0.3
	2100-075-R05	10	10	25	75	0.5
	2100-075-R10	10	10	25	75	1
	2100-075-R15	10	10	25	75	1.5
	2100-075-R20	10	10	25	75	2
	2100-075-R25	10	10	25	75	2.5
	2100-075-R30	10	10	25	75	3
	2120-075-R03	12	12	30	75	0.3
	2120-075-R05	12	12	30	75	0.5
	2120-075-R10	12	12	30	75	1
	2120-075-R15	12	12	30	75	1.5
	2120-075-R20	12	12	30	75	2
	2120-075-R25	12	12	30	75	2.5
	2120-075-R30	12	12	30	75	3

IPLRE2000 (Long radius)



ØD	Tolerance
Ø3~Ø12	0.00~ -0.02

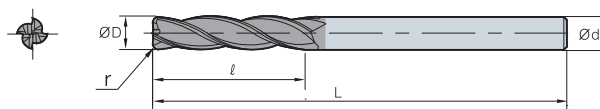


(mm)

Designation		ØD	Ød	ℓ	L	r
IPLRE 2	2030-075-R03	3	3	8	75	0.3
	2030-075-R05	3	3	8	75	0.5
	2030-075-R10	3	3	8	75	1
	2040-075-R03	4	4	10	75	0.3
	2040-075-R05	4	4	10	75	0.5
	2040-075-R10	4	4	10	75	1
	2040-075-R15	4	4	10	75	1.5
	2060-100-R03	6	6	15	100	0.3
	2060-100-R05	6	6	15	100	0.5
	2060-100-R10	6	6	15	100	1
	2060-100-R15	6	6	15	100	1.5
	2060-100-R20	6	6	15	100	2
	2080-100-R03	8	8	20	100	0.3
	2080-100-R05	8	8	20	100	0.5
	2080-100-R10	8	8	20	100	1
	2080-100-R15	8	8	20	100	1.5
	2080-100-R20	8	8	20	100	2
	2080-100-R25	8	8	20	100	2.5
	2080-100-R30	8	8	20	100	3
	2100-100-R03	10	10	25	100	0.3
	2100-100-R05	10	10	25	100	0.5
	2100-100-R10	10	10	25	100	1
	2100-100-R15	10	10	25	100	1.5
	2100-100-R20	10	10	25	100	2
	2100-100-R25	10	10	25	100	2.5
	2100-100-R30	10	10	25	100	3
	2120-100-R03	12	12	30	100	0.3
	2120-100-R05	12	12	30	100	0.5
	2120-100-R10	12	12	30	100	1
	2120-100-R15	12	12	30	100	1.5
	2120-100-R20	12	12	30	100	2
	2120-100-R25	12	12	30	100	2.5
	2120-100-R30	12	12	30	100	3



IPRE4000 (Radius)



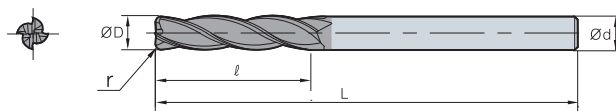
ØD	Tolerance
Ø2~Ø12	0.00~-0.02



(mm)

Designation		ØD	Ød	ℓ	L	r
IPRE 4	4020-050-R02	2	4	6	50	0.2
	4020-050-R03	2	4	6	50	0.3
	4020-050-R05	2	4	6	50	0.5
	4025-050-R02	2.5	4	8	50	0.2
	4030-050-R02-S3	3	3	8	50	0.2
	4030-050-R03-S3	3	3	8	50	0.3
	4030-050-R05-S3	3	3	8	50	0.5
	4030-050-R10-S3	3	3	8	50	1
	4030-050-R02	3	4	8	50	0.2
	4030-050-R03	3	4	8	50	0.3
	4030-050-R05	3	4	8	50	0.5
	4030-050-R10	3	4	8	50	1
	4040-050-R02	4	4	10	50	0.2
	4040-050-R03	4	4	10	50	0.3
	4040-050-R05	4	4	10	50	0.5
	4040-050-R10	4	4	10	50	1
	4040-050-R15	4	4	10	50	1.5
	4050-050-R02	5	6	13	50	0.2
	4050-050-R03	5	6	13	50	0.3
	4050-050-R05	5	6	13	50	0.5
	4050-050-R10	5	6	13	50	1
	4060-050-R02	6	6	15	50	0.2
	4060-050-R03	6	6	15	50	0.3
	4060-050-R05	6	6	15	50	0.5
	4060-050-R10	6	6	15	50	1
	4060-050-R15	6	6	15	50	1.5
	4060-050-R20	6	6	15	50	2
	4080-060-R03	8	8	20	60	0.3
	4080-060-R05	8	8	20	60	0.5
	4080-060-R10	8	8	20	60	1
	4080-060-R15	8	8	20	60	1.5
	4080-060-R20	8	8	20	60	2
	4080-060-R25	8	8	20	60	2.5
	4080-060-R30	8	8	20	60	3
	4100-075-R03	10	10	25	75	0.3
	4100-075-R05	10	10	25	75	0.5
	4100-075-R10	10	10	25	75	1
	4100-075-R15	10	10	25	75	1.5
	4100-075-R20	10	10	25	75	2
	4100-075-R25	10	10	25	75	2.5
	4100-075-R30	10	10	25	75	3
	4120-075-R03	12	12	30	75	0.3
	4120-075-R05	12	12	30	75	0.5
	4120-075-R10	12	12	30	75	1
	4120-075-R15	12	12	30	75	1.5
	4120-075-R20	12	12	30	75	2
	4120-075-R25	12	12	30	75	2.5
	4120-075-R30	12	12	30	75	3

IPLRE4000 (Long radius)



ØD	Tolerance
Ø3~Ø12	0.00~ -0.02



(mm)

Designation		ØD	Ød	ℓ	L	r
IPLRE 	4030-075-R03	3	3	8	75	0.3
	4030-075-R05	3	3	8	75	0.5
	4030-075-R10	3	3	8	75	1
	4040-075-R03	4	4	10	75	0.3
	4040-075-R05	4	4	10	75	0.5
	4040-075-R10	4	4	10	75	1
	4040-075-R15	4	4	10	75	1.5
	4060-100-R03	6	6	15	100	0.3
	4060-100-R05	6	6	15	100	0.5
	4060-100-R10	6	6	15	100	1
	4060-100-R15	6	6	15	100	1.5
	4060-100-R20	6	6	15	100	2
	4080-100-R03	8	8	20	100	0.3
	4080-100-R05	8	8	20	100	0.5
	4080-100-R10	8	8	20	100	1
	4080-100-R15	8	8	20	100	1.5
	4080-100-R20	8	8	20	100	2
	4080-100-R25	8	8	20	100	2.5
	4080-100-R30	8	8	20	100	3
	4100-100-R03	10	10	25	100	0.3
	4100-100-R05	10	10	25	100	0.5
	4100-100-R10	10	10	25	100	1
	4100-100-R15	10	10	25	100	1.5
	4100-100-R20	10	10	25	100	2
	4100-100-R25	10	10	25	100	2.5
	4100-100-R30	10	10	25	100	3
	4120-100-R03	12	12	30	100	0.3
	4120-100-R05	12	12	30	100	0.5
	4120-100-R10	12	12	30	100	1
	4120-100-R15	12	12	30	100	1.5
	4120-100-R20	12	12	30	100	2
	4120-100-R25	12	12	30	100	2.5
	4120-100-R30	12	12	30	100	3



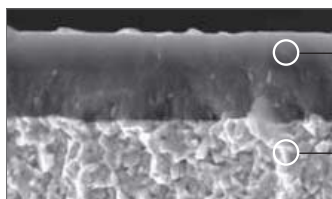
Highly efficient and economical endmill for general cutting

Z⁺ Endmill

- Wide range of workpiece materials up to H_RC47
- Wide application range from roughing to finishing
- Increased tool life thanks to a new substrate and advanced coating layers
- Prevented chipping and extended cutting time thanks to its optimized blade design

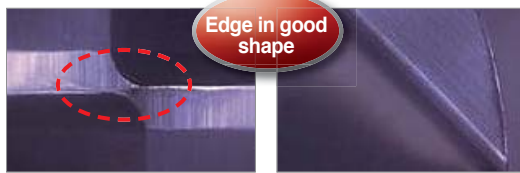
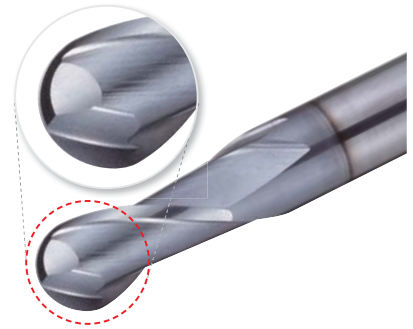
Features

- Wide range of workpiece materials - Carbon steel, alloy steel, cast iron, etc
- Extended tool life - Newly invented substrate and high-tech coating layers applied
- Higher productivity - Wide application range from roughing to finishing



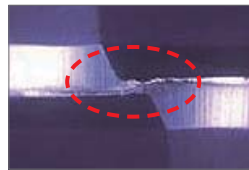
PC320U

- AlCrSiN coating layer
: Coating lubrication making possible high temperature/high speed machining
- Ultra-fine substrate
: Substrate with excellent wear resistance applied



Z⁺ Endmill

Exceptional cutting edge rigidity

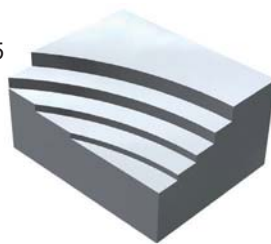


Competitor

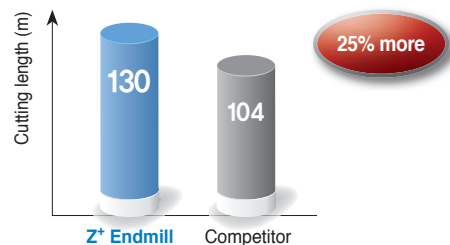


Application examples

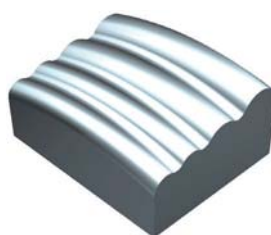
- **Workpiece** Carbon steel (C45, ~H_RC20)
- **Cutting conditions** vc (m/min) = 180, fz (mm/t) = 0.05
ap (mm) = 8, dry
- **Tools** ZPFE4080-060



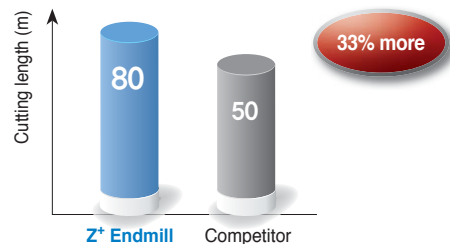
Test result



- **Workpiece** Carbon steel (C45, ~H_RC20)
- **Cutting conditions** vc (m/min) = 130, fz (mm/t) = 0.1
ap (mm) = 0.5, dry
- **Tools** ZPBE2080-100



Test result

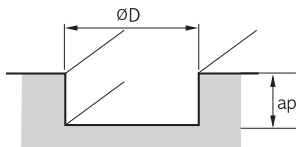


F Technical Information for Z⁺ Endmill

Recommended cutting conditions (ZPFE2000/ZPSFE2000 flat)

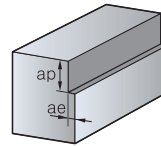
Workpiece Cutting conditions Diameter (Ø)	Alloy steel and Carbon steel (under HRC30)		Pre-hardened steel (HRC30~47)		Stainless steel	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
1	19,745	175	13,057	100	10,500	70
2	11,560	190	7,560	120	6,300	90
3	8,920	210	5,560	140	4,620	120
4	7,560	300	4,620	180	3,880	150
5	6,300	320	3,780	190	3,160	160
6	5,560	350	3,360	220	2,840	180
8	4,200	380	2,520	200	2,100	180
10	3,260	330	2,000	160	1,680	160
12	2,740	280	1,680	130	1,360	130
16	2,200	220	1,360	110	1,060	110

Application tip



Slotting depth (ap)

- $D \leq \varnothing 2.5$ ($ap = 0.3D$)
- $D > \varnothing 2.5$ ($ap = 0.5D$)



Shouldering depth (ap)

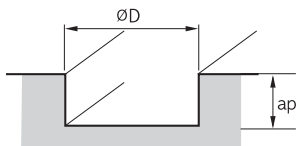
- $D \leq \varnothing 2.5$ ($ap = 1.5D$, $ae = 0.05D$)
- $D > \varnothing 2.5$ ($ap = 1.5D$, $ae = 0.1D$)

* Workpiece should be clamped rigidly. In case of vibrations, reduce RPM and feed rate by the same ratio

Recommended cutting conditions (ZPFE4000/ZPSFE4000 flat)

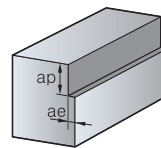
Workpiece Cutting conditions Diameter (Ø)	Alloy steel and Carbon steel (under HRC30)		Pre-hardened steel (HRC30~47)		Stainless steel	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
2	11,560	280	7,560	170	6,300	140
3	8,920	320	5,560	200	4,620	170
4	7,560	570	4,620	350	3,880	280
5	6,300	600	3,780	360	3,160	300
6	5,560	660	3,360	410	2,840	330
8	4,200	710	2,520	380	2,100	350
10	3,260	610	2,000	300	1,680	300
12	2,740	520	1,680	250	1,360	240
16	2,200	410	1,360	200	1,100	200

Application tip



Slotting depth (ap)

- $D \leq \varnothing 2.5$ ($ap = 0.3D$)
- $D > \varnothing 2.5$ ($ap = 0.5D$)



Shouldering depth (ap)

- $D \leq \varnothing 2.5$ ($ap = 1.5D$, $ae = 0.05D$)
- $D > \varnothing 2.5$ ($ap = 1.5D$, $ae = 0.1D$)

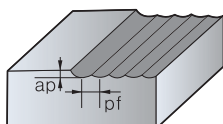
* Workpiece should be clamped rigidly. In case of vibrations, reduce RPM and feed rate by the same ratio



Recommended cutting conditions (ZPBE2000 ball)

Workpiece Cutting conditions Diameter (Ø)	Alloy steel and Carbon steel (under HRC30)		Pre-hardened steel (HRC30~47)	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
1	30,000	2,880	30,000	2,520
1.2	30,000	3,060	28,800	2,580
1.5	30,000	3,240	28,800	2,700
2	29,820	3,420	28,680	2,880
3	19,860	3,600	19,080	3,180
4	14,940	3,600	14,340	3,180
5	11,160	3,480	10,680	2,940
6	8,340	2,910	8,040	2,460
8	6,660	2,520	6,420	2,100
10	5,580	2,220	5,340	1,860
12	4,170	1,770	4,008	1,500

Application tip



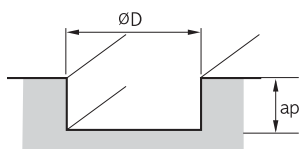
- $ap = 0.03D$
- $pf = 0.05D$

※ Workpiece should be clamped rigidly. In case of vibrations, reduce RPM and feed rate by the same ratio

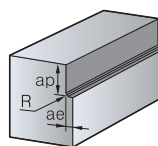
Recommended cutting conditions (ZPRE2000 radius)

Workpiece Cutting conditions Diameter (Ø)	Alloy steel and Carbon steel (under HRC30)		Pre-hardened steel (HRC30~47)		Stainless steel	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
6	5,300	420	3,200	240	2,400	180
8	4,000	450	2,700	210	2,040	150
10	3,200	390	2,400	180	1,600	120
12	2,700	330	2,040	150	1,300	100
14	2,400	270	1,600	120	1,000	70
16	2,040	200	1,300	100	1,300	60

Application tip



- Slotting depth (ap)
- $ap: \leq 0.3D$



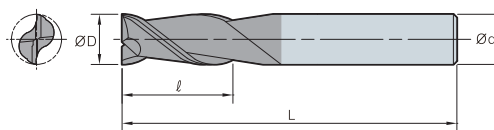
- Shouldering depth (ap)
- $ap: \leq 1.5D$
- $ae: \leq 0.1D$

※ Workpiece should be clamped rigidly. In case of vibrations, reduce RPM and feed rate by the same ratio

Notice

- Please adjust the recommended cutting conditions properly, according to the condition of your machines, the target shapes, and your purpose for machining
- Workpiece should be clamped rigidly. In case of vibrations, reduce RPM and feed rate by the same ratio
- In case of overhang over 3D, reduce RPM and feed rate

ZPFE2000 (Flat)



ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03

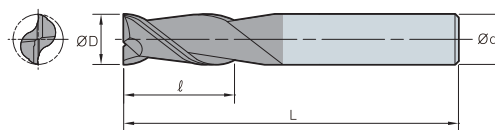


(mm)

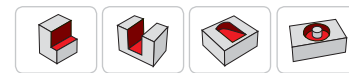
Designation	ØD	Ød	ℓ	L
ZPFE				
2010-050-S4	1.0	4	3	50
2015-050-S4	1.5	4	4	50
2020-050-S4	2.0	4	6	50
2025-050-V6S4	2.5	4	6	50
2025-050-V8S4	2.5	4	8	50
2030-050-S4	3.0	4	9	50
2030-050	3.0	6	9	50
2035-050-S4	3.5	4	9	50
2035-050	3.5	6	9	50
2040-050-S4	4.0	4	11	50
2040-050	4.0	6	11	50
2045-050	4.5	6	11	50
2050-050	5.0	6	13	50
2060-050	6.0	6	16	50
2065-060	6.5	8	16	60
2070-060	7.0	8	20	60
2075-060	7.5	8	20	60
2080-060	8.0	8	20	60
2085-075	8.5	10	23	75
2090-075	9.0	10	23	75
2095-075	9.5	10	25	75
2100-075	10.0	10	25	75
2105-075	10.5	12	26	75
2110-075	11.0	12	28	75
2120-075	12.0	12	30	75
2140-100	14.0	14	34	100
2150-090	15.0	16	36	90
2160-100	16.0	16	36	100
2170-100	17.0	20	40	100
2180-100	18.0	18	40	100
2190-100	19.0	20	40	100
2200-100	20.0	20	40	100



ZPSFE2000 (Short flat)



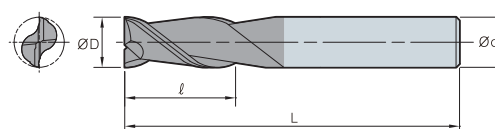
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	ØD	Ød	ℓ	L
ZPSFE				
2 2010-050-S4	1.0	4	2	50
2015-050-S4	1.5	4	2	50
2020-050-S4	2.0	4	3	50
2025-050-S4	2.5	4	4	50
2030-050-S4	3.0	4	5	50
2040-050-S4	4.0	4	6	50
2050-050	5.0	6	8	50
2060-050	6.0	6	9	50
2070-050	7.0	8	10	50
2080-050	8.0	8	12	50
2100-075	10.0	10	15	75
2120-075	12.0	12	18	75
2160-100	16.0	16	24	100

ZPLFE2000 (Long flat)



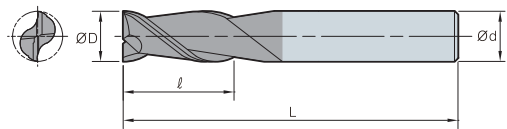
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	ØD	Ød	ℓ	L
ZPLFE				
2 2020-075-S4	2.0	4	6	75
2030-075-S4	3.0	4	9	75
2030-075	3.0	6	12	75
2040-075-S4	4.0	4	11	75
2050-075	5.0	6	20	75
2060-100	6.0	6	16	100
2060-100-V20S6	6.0	6	20	100
2080-075	8.0	8	20	75
2080-100	8.0	8	25	100
2100-100	10.0	10	30	100
2120-100	12.0	12	35	100
2160-150	16.0	16	36	150
2200-150	20.0	20	45	150

ZPLFE2000 (Long flute)



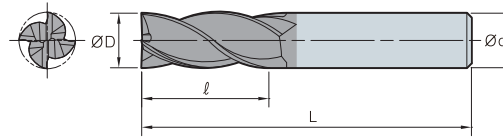
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation		ØD	Ød	ℓ	L
ZPLFE 2	2020-075-V15S4	2.0	4	15	75
	2030-075-V25S4	3.0	4	25	75
	2040-075-V30S4	4.0	4	30	75
	2050-075-V30S6	5.0	6	30	75
	2060-075-V35S6	6.0	6	35	75
	2080-100-V40S8	8.0	8	40	100
	2100-100-V45S10	10.0	10	45	100
	2120-100-V50S12	12.0	12	50	100
	2140-100-V55S14	14.0	14	55	100
	2160-150-V50S16	16.0	16	50	150
	2160-150-V60S16	16.0	16	60	150
	2180-150-V65S18	18.0	18	65	150
	2200-150-V70S20	20.0	20	70	150



ZPFE4000 (Flat)

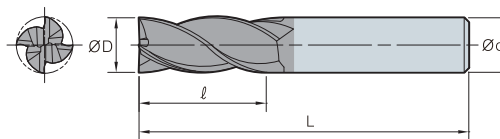
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	ØD	Ød	ℓ	L
ZPFE				
4010-050-S4	1.0	4	3	50
4015-050-S4	1.5	4	5	50
4015-050	1.5	6	5	50
4020-050-S4	2.0	4	6	50
4020-050	2.0	6	6	50
4025-050-S4	2.5	4	8	50
4025-050	2.5	6	8	50
4030-050	3.0	6	6	50
4030-050-S4	3.0	4	9	50
4030-050-V9S6	3.0	6	9	50
4035-050-S4	3.5	4	11	50
4035-050	3.5	6	9	50
4040-050-S4	4.0	4	11	50
4040-050	4.0	6	11	50
4045-050	4.5	6	11	50
4050-050	5.0	6	8	50
4050-050-V13S6	5.0	6	13	50
4055-050	5.5	6	16	50
4060-050	6.0	6	16	50
4065-060	6.5	8	16	60
4070-060	7.0	8	20	60
4075-060	7.5	8	20	60
4080-060	8.0	8	20	60
4085-075	8.5	10	23	75
4090-075	9.0	10	23	75
4095-075	9.5	10	23	75
4100-075	10.0	10	25	75
4110-075	11.0	12	28	75
4120-075	12.0	12	30	75
4130-100	13.0	14	32	100
4140-075	14.0	14	32	75
4140-100	14.0	14	34	100
4150-100	15.0	16	36	100
4160-100	16.0	16	36	100
4160-100-V40S16	16.0	16	40	100
4160-100-V45S16	16.0	16	45	100
4170-100-S18	17.0	18	38	100
4180-100-S18	18.0	18	45	100
4200-100-S20	20.0	20	45	100

ZPSFE4000 (Short flat)



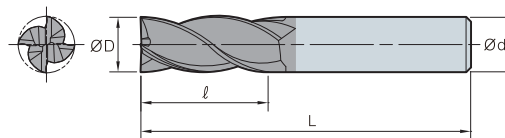
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	ØD	Ød	ℓ	L
ZPSFE				
4010-050-S4	1.0	4	2	50
4015-050-S4	1.5	4	2	50
4020-050-S4	2.0	4	3	50
4025-050-S4	2.5	4	4	50
4030-050-S4	3.0	4	5	50
4040-050-S4	4.0	4	6	50
4050-050	5.0	6	8	50
4060-050	6.0	6	9	50
4070-050	7.0	8	10	50
4080-050	8.0	8	12	50
4100-075	10.0	10	15	75
4120-075	12.0	12	18	75
4160-100	16.0	16	24	100



ZPLFE4000 (Long flat)

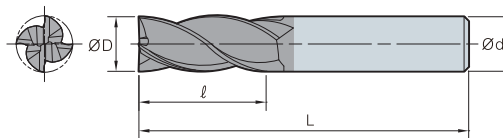
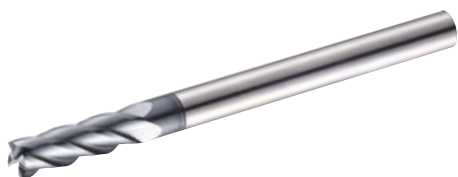
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation		ØD	Ød	ℓ	L
ZPLFE 4	4020-075-S4	2.0	4	10	75
	4030-075-S4	3.0	4	12	75
	4040-075-S4	4.0	4	11	75
	4040-050-V15S4	4.0	4	15	75
	4050-075	5.0	6	20	75
	4060-075	6.0	6	16	75
	4060-075-V20S6	6.0	6	20	75
	4080-075	8.0	8	20	75
	4080-100-S8	8.0	8	25	100
	4100-100	10.0	10	30	100
	4100-100-V35S10	10.0	10	35	100
	4120-100	12.0	12	35	100
	4160-150	16.0	16	36	150
	4200-150	20.0	20	45	150

ZPLFE4000 (Long flute)



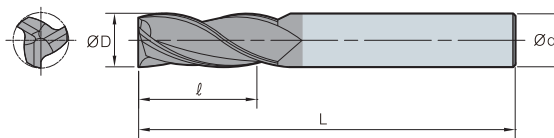
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	ØD	Ød	ℓ	L
ZPLFE				
4 4010-050-V04S4	1.0	4	4	50
4020-050-V10S4	2.0	4	10	50
4030-060-V15S4	3.0	4	15	60
4030-060-V16S6	3.0	6	16	60
4040-060-V20S4	4.0	4	20	60
4040-075-V20S6	4.0	6	20	75
4040-075-V30S4	4.0	4	30	75
4050-075-V25S6	5.0	6	25	75
4050-075-V30S6	5.0	6	30	75
4060-075-V30S6	6.0	6	30	75
4060-075-V35S6	6.0	6	35	75
4080-100-V35S8	8.0	8	35	100
4080-100-V40S8	8.0	8	40	100
4100-100-V45S10	10.0	10	45	100
4100-100-V50S10	10.0	10	50	100
4120-100-V45S12	12.0	12	45	100
4120-100-V50S12	12.0	12	50	100
4140-100-V45S14	14.0	14	45	100
4160-150-V50S16	16.0	16	50	150
4160-150-V60S16	16.0	16	60	150
4160-150-V70S16	16.0	16	70	150
4180-150-V70S18	18.0	18	70	150
4200-150-V70S20	20.0	20	70	150

ZPFE3000 (Flat)



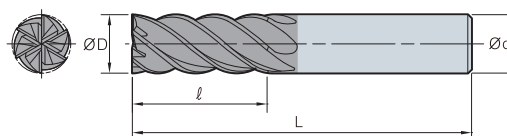
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	ØD	Ød	ℓ	L
ZPFE				
 3020-050-S4	2.0	4	6	50
3030-050-S4	3.0	4	9	50
3040-050-S4	4.0	4	11	50
3050-050	5.0	6	13	50
3060-050	6.0	6	16	50
3065-060	6.5	8	16	60
3080-060	8.0	8	20	60
3095-075	9.5	10	24	75
3100-075	10.0	10	25	75
3120-075	12.0	12	30	75
3106-100	16.0	16	36	100
3180-100	18.0	18	40	100
3200-100	20.0	20	45	100
3250-100	25.0	25	50	100

ZPFE6000 (Flat)



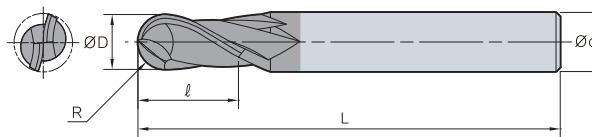
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	ØD	Ød	ℓ	L
ZPFE				
 6060-050	6.0	6	15	50
6080-060	8.0	8	20	60
6100-075	10.0	10	25	75
6120-075	12.0	12	30	75
6160-100	16.0	16	36	100
6200-100	20.0	20	45	100

ZPBE2000 (Ball)



ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03

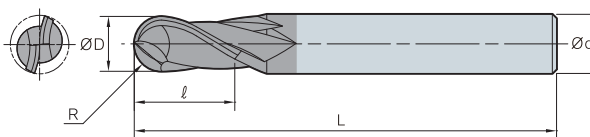
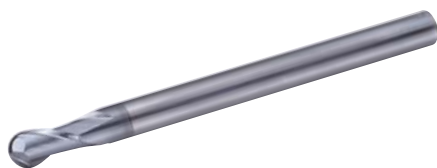


(mm)

Designation	R	ØD	Ød	ℓ	L
ZPBE					
2008-050-S4	0.4	0.8	4	1.6	50
2009-050-S4	0.5	0.9	4	1.8	50
2010-050-S4	0.5	1.0	4	2	50
2015-050-S4	0.8	1.5	4	3	50
2020-050-S4	1.0	2.0	4	4	50
2020-050	1.0	2.0	6	4	50
2025-050-S4	1.3	2.5	4	5	50
2030-050-S4	1.5	3.0	4	6	50
2030-050	1.5	3.0	6	6	50
2040-050-S4	2.0	4.0	4	8	50
2040-050	2.0	4.0	6	8	50
2050-050	2.5	5.0	6	10	50
2060-050	3.0	6.0	6	12	50
2070-060	3.5	7.0	8	14	60
2080-060	4.0	8.0	8	14	60
2090-075	4.5	9.0	10	16	75
2100-075	5.0	10.0	10	18	75
2110-075	5.5	11.0	12	20	75
2120-075	6.0	12.0	12	22	75
2130-090	6.5	13.0	14	26	90
2140-090	7.0	14.0	14	26	90
2150-090	7.5	15.0	16	30	90
2160-100	8.0	16.0	16	30	100
2200-100	10.0	20.0	20	38	100



ZPLBE2000 (Long ball)



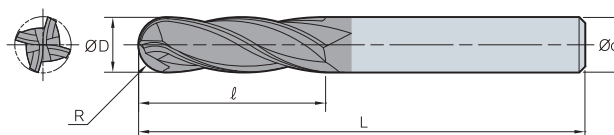
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	R	ØD	Ød	ℓ	L
ZPLBE					
2020-075-S4	1.0	2.0	4	4	75
2030-075-S4	1.5	3.0	4	6	75
2030-075	1.5	3.0	6	6	75
2040-075-S4	2.0	4.0	4	8	75
2040-075	2.0	4.0	6	8	75
2050-075	2.5	5.0	6	10	75
2060-075	3.0	6.0	6	12	75
2080-100	4.0	8.0	8	14	100
2100-100	5.0	10.0	10	18	100
2120-100	6.0	12.0	12	20	100

ZPBE4000 (Ball)



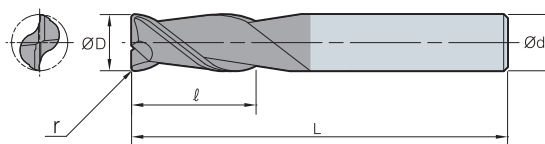
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	R	ØD	Ød	ℓ	L
ZPBE					
4020-050-S4	1.0	2.0	4	4	50
4025-050-S4	1.3	2.5	4	5	50
4030-050-S4	1.5	3.0	4	6	50
4030-050	1.5	3.0	6	6	50
4040-050-S4	2.0	4.0	4	8	50
4040-050	2.0	4.0	6	8	50
4050-050	2.5	5.0	6	10	50
4060-050	3.0	6.0	6	12	50
4070-060	3.5	7.0	8	14	60
4080-060	4.0	8.0	8	14	60
4090-075	4.5	9.0	10	16	75
4100-075	5.0	10.0	10	18	75
4110-075	5.5	11.0	12	20	75
4120-075	6.0	12.0	12	22	75
4140-075	7.0	14.0	14	24	75
4160-100	8.0	16.0	16	30	100
4200-100	10.0	20.0	20	38	100

ZPRE2000 (Radius)



ØD	Tolerance
~Ø11.9	0.00~-0.02
Ø12~	0.00~-0.03

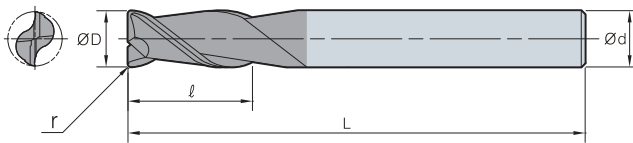
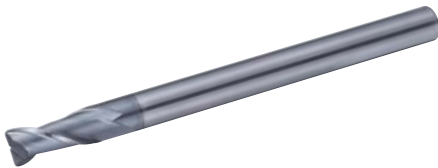


(mm)

Designation	ØD	Ød	ℓ	L	r
ZPRE					
2010-050-S4-R02	1.0	4	3	50	0.2
2020-050-S4-R02	2.0	4	6	50	0.2
2030-050-S4-R02	3.0	4	9	50	0.2
2030-050-R02	3.0	6	9	50	0.2
2030-050-S4-R03	3.0	4	9	50	0.3
2030-050-R03	3.0	6	9	50	0.3
2030-050-S4-R05	3.0	4	9	50	0.5
2030-050-R05	3.0	6	9	50	0.5
2040-050-S4-R02	4.0	4	11	50	0.2
2040-050-R02	4.0	6	11	50	0.2
2040-050-S4-R03	4.0	4	11	50	0.3
2040-050-R03	4.0	6	11	50	0.3
2040-050-S4-R05	4.0	4	11	50	0.5
2040-050-R05	4.0	6	11	50	0.5
2040-050-S4-R10	4.0	4	11	50	1.0
2050-050-R02	5.0	6	13	50	0.2
2050-050-R03	5.0	6	13	50	0.3
2050-050-R05	5.0	6	13	50	0.5
2050-050-R10	5.0	6	13	50	1.0
2060-050-R05	6.0	6	16	50	0.5
2060-050-R10	6.0	6	16	50	1.0
2060-050-R15	6.0	6	16	50	1.5
2060-050-R20	6.0	6	16	50	2.0
2080-060-R03	8.0	8	20	60	0.3
2080-060-R05	8.0	8	20	60	0.5
2080-060-R10	8.0	8	20	60	1.0
2080-060-R15	8.0	8	20	60	1.5
2080-060-R20	8.0	8	20	60	2.0
2100-075-R03	10.0	10	25	75	0.3
2100-075-R06	10.0	10	25	75	0.6
2100-075-R10	10.0	10	25	75	1.0
2100-075-R15	10.0	10	25	75	1.5
2100-075-R20	10.0	10	25	75	2.0
2100-075-R30	10.0	10	25	75	3.0
2120-075-R05	12.0	12	30	75	0.5
2120-075-R10	12.0	12	30	75	1.0
2120-075-R15	12.0	12	30	75	1.5
2120-075-R20	12.0	12	30	75	2.0
2120-075-R30	12.0	12	30	75	3.0
2160-100-R10	16.0	16	36	100	1.0
2160-100-R20	16.0	16	36	100	2.0
2160-100-R30	16.0	16	36	100	3.0



ZPLRE2000 (Long radius)



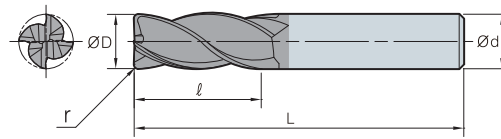
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation		ØD	Ød	ℓ	L	r
ZPLRE 2	2060-075-R05	6.0	6	16	75	0.5
	2060-075-R10	6.0	6	16	75	1.0
	2060-075-R15	6.0	6	16	75	1.5
	2080-100-R05	8.0	8	20	100	0.5
	2080-100-R10	8.0	8	20	100	1.0
	2080-100-R15	8.0	8	20	100	1.5
	2100-100-R05	10.0	10	25	100	0.5
	2100-100-R10	10.0	10	25	100	1.0
	2100-100-R15	10.0	10	25	100	1.5
	2100-100-R20	10.0	10	25	100	2.0
	2120-100-R05	12.0	12	30	100	0.5
	2120-100-R10	12.0	12	30	100	1.0
	2120-100-R15	12.0	12	30	100	1.5
	2120-100-R20	12.0	12	30	100	2.0
	2160-150-R05	16.0	16	36	150	0.5
	2160-150-R10	16.0	16	36	150	1.0
	2160-150-R15	16.0	16	36	150	1.5
	2160-150-R20	16.0	16	36	150	2.0

ZPRE4000 (Radius)



ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



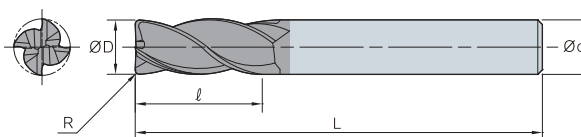
(mm)

Designation		ØD	Ød	ℓ	L	r
ZPRE 4	4015-050-S4-R02	1.5	4	5	50	0.2
	4020-050-S4-R02	2.0	4	6	50	0.2
	4030-050-S4-R02	3.0	4	9	50	0.2
	4030-050-S4-R03	3.0	4	9	50	0.3
	4030-050-S4-R05	3.0	4	9	50	0.5
	4040-050-S4-R02	4.0	4	11	50	0.2
	4040-050-S4-R03	4.0	4	11	50	0.3
	4040-050-S4-R05	4.0	4	11	50	0.5
	4040-050-S4-R10	4.0	4	11	50	1.0
	4045-050-R10	4.5	6	12	50	1.0
	4050-050-R02	5.0	6	13	50	0.2
	4050-050-R05	5.0	6	13	50	0.5
	4050-050-R10	5.0	6	13	50	1.0
	4050-050-R15	5.0	6	13	50	1.5
	4060-050-R05	6.0	6	16	50	0.5
	4060-050-R10	6.0	6	16	50	1.0
	4060-050-R15	6.0	6	16	50	1.5
	4080-060-R03	8.0	8	20	60	0.3
	4080-060-R05	8.0	8	20	60	0.5
	4080-060-R10	8.0	8	20	60	1.0
	4080-060-R15	8.0	8	20	60	1.5
	4080-060-R20	8.0	8	20	60	2.0
	4100-075-R03	10.0	10	25	75	0.3
	4100-075-R05	10.0	10	25	75	0.5
	4100-075-R10	10.0	10	25	75	1.0
	4100-075-R15	10.0	10	25	75	1.5
	4100-075-R20	10.0	10	25	75	2.0
	4100-075-R25	10.0	10	25	75	2.5
	4100-075-R30	10.0	10	25	75	3.0
	4120-075-R05	12.0	12	30	75	0.5
	4120-075-R10	12.0	12	30	75	1.0
	4120-075-R15	12.0	12	30	75	1.5
	4120-075-R20	12.0	12	30	75	2.0
	4120-075-R25	12.0	12	30	75	2.5
	4120-075-R30	12.0	12	30	75	3.0
	4160-100-R05	16.0	16	36	100	0.5
	4160-100-R10	16.0	16	36	100	1.0
	4160-100-R20	16.0	16	36	100	2.0
	4160-100-R30	16.0	16	36	100	3.0



F

Endmills

ZPLRE4000 (Long radius)

ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation		ØD	Ød	ℓ	L	r
ZPLRE 4	4060-075-R05	6.0	6	16	75	0.5
	4060-075-R10	6.0	6	16	75	1.0
	4060-075-R15	6.0	6	16	75	1.5
	4080-100-R05	8.0	8	20	100	0.5
	4080-100-R10	8.0	8	20	100	1.0
	4080-100-R15	8.0	8	20	100	1.5
	4080-100-R20	8.0	8	20	100	2.0
	4100-100-R05	10.0	10	25	100	0.5
	4100-100-R10	10.0	10	25	100	1.0
	4100-100-R15	10.0	10	25	100	1.5
	4100-100-R20	10.0	10	25	100	2.0
	4120-100-R05	12.0	12	30	100	0.5
	4120-100-R10	12.0	12	30	100	1.0
	4120-100-R15	12.0	12	30	100	1.5
	4120-100-R20	12.0	12	30	100	2.0
	4120-100-R30	12.0	12	30	100	3.0
	4160-150-R05	16.0	16	36	150	0.5
	4160-150-R10	16.0	16	36	150	1.0
	4160-150-R15	16.0	16	36	150	1.5
	4160-150-R20	16.0	16	36	150	2.0
	4160-150-R30	16.0	16	36	150	3.0

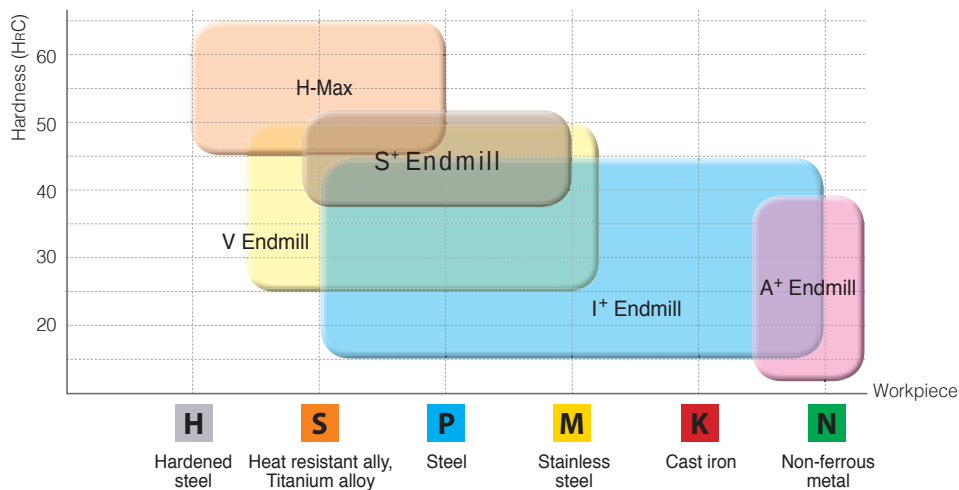
F Technical Information for S⁺ Endmill

Stainless endmill

S⁺ Endmill

- Strong cutting edge ensures long tool life
- Special coating with high oxidation resistance
- High rake angle and curvilinear chip pocket allow chip evacuation
- Special cutting edge prevents hardening of tools
- Optimal machinability in stainless steel machining
- Available for steel, alloy steel and hardening steel machining
- Available for multiple operations (Shouldering, slotting and ramping etc.)

Application area



Performance evaluation

- **Workpiece** STS304
- **Cutting conditions** Diameter = Ø8.0, n (min⁻¹) = 4.000, vc (m/min) = 100, vf (mm/min) = 480, fz (mm/t) = 0.04, ap (mm) = 8, ae (mm) = 0.8, dry
- **Tools** SPFE4080-060

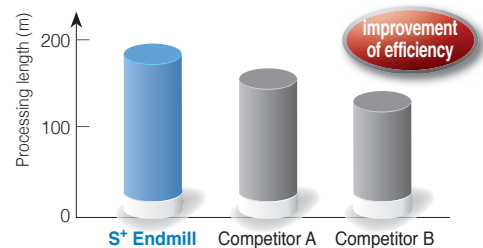


S⁺ Endmill

Competitor A

Competitor B

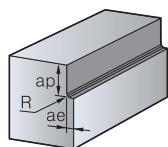
Test result



Recommend cutting conditions

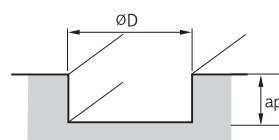
Workpiece Condition Diameter (Ø)	Stainless steel STS		Titanium alloy /Inconel		Normal steel (SS, SM) (Under HRC 25)		Alloy steel (SCM) (HRC 25~35)		Hardened steel (STD) (HRC 40~50)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
2	5,500	240	2,600	90	9,000	540	6,000	3,200	4,000	240
4	4,000	260	2,000	90	6,600	600	4,500	340	3,000	280
6	3,000	360	1,200	90	4,800	720	3,000	360	2,500	280
8	2,000	390	1,000	100	3,600	750	2,200	460	2,000	300
10	1,700	410	800	120	2,800	750	1,800	460	1,500	300
12	1,500	380	700	100	2,400	710	1,500	410	1,200	280
14	1,200	320	600	95	2,200	660	1,300	370	1,000	270
16	1,000	270	500	90	1,800	490	1,100	320	800	230
20	750	250	400	85	900	270	900	270	600	200

Application tip



Shouldering depth (ap) and radial depth (ae)

- Normal steel, Alloy steel, Stainless steel: ae = 0.1D, ap = 1.5D
- Titanium alloy, Inconel, Hardened steel: ae = 0.05D, ap = 1.5D



Slotting depth (ap)

- Normal steel, Alloy steel: ap = 1.0D
- Stainless steel: ap = 0.3D
- Titanium alloy, Inconel, Hardened steel: ap = 0.2D

Stainless steel machining

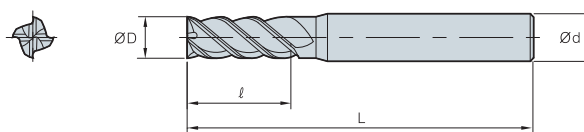
- Low thermal conductivity of stainless steel alloy causes conducting heat to the tool and fracture and chipping
- Stainless steel alloy machining gets produces high wear and high cutting resistance
- High temperature in stainless steel alloy machining lowers cutting conditions and decrease the quality of surface roughness

Trouble shooting for stainless steel

- Getting low cutting conditions
- Getting deeper ap than the work hardened layer and use tools with sharp cutting edge
- Use coolant



SPFE4000 (Flat)

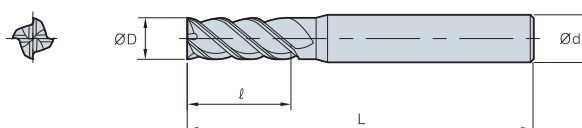


ØD	Tolerance
Ø1~Ø12	0.00~ -0.02

(mm)

Designation		ØD	Ød	ℓ	L
SPFE 4	4010-050	1.0	4	3	50
	4015-050	1.5	4	4	50
	4020-050	2.0	4	6	50
	4025-050	2.5	4	8	50
	4030-050	3.0	4	9	50
	4030-050-S6	3.0	6	9	50
	4040-050	4.0	4	11	50
	4040-050-S6	4.0	6	11	50
	4050-050	5.0	6	13	50
	4060-050	6.0	6	16	50
	4080-060	8.0	8	20	60
	4100-075	10.0	10	30	75
	4120-075	12.0	12	32	75

SPLFE4000 (Long flat)



ØD	Tolerance
Ø1~Ø12	0.00~ -0.02

(mm)

Designation		ØD	Ød	ℓ	L
SPLFE 4	4010-050	1.0	4	4	50
	4015-050	1.5	4	6	50
	4020-050	2.0	4	8	50
	4025-050	2.5	4	10	50
	4030-050-S6	3.0	6	12	50
	4040-050-S6	4.0	6	16	50
	4050-060	5.0	6	20	60
	4060-060	6.0	6	24	60
	4080-075	8.0	8	35	75
	4100-100	10.0	10	45	100
	4120-100	12.0	12	45	100



High efficient roughing endmill

R⁺ Endmill **new**

- Cost-effective cutting-edge design for rough machining
- Specifically designed corners as irregular flute spacing and lead angle

Feature

- Excellent machining efficiency - Special design for medium to rough cutting
- Longer cutting life - Extended tool cost thanks to newly applied grades
- Higher cutting performance - Blade design ideal for roughing

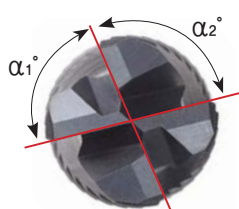


Lower cutting

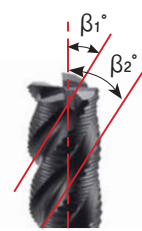
- Ideal for medium to rough cutting
- Special edge design

Soft cutting

- Serrated cutting edges
- 3 Combo R



- Irregular flute spacing to prevent chattering ($\alpha_1 \neq \alpha_2$)



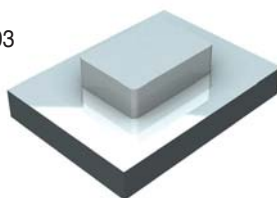
- Irregular lead angles to disperse cutting force ($\beta_1 \neq \beta_2$)

Grade system

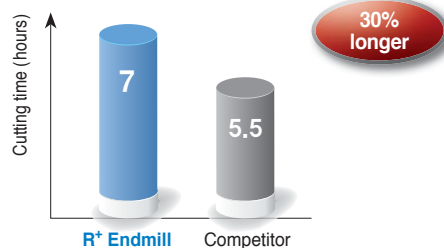
Carbide roughing		HSS roughing	
FN30T	Carbide, uncoated	HN30T	HSS, uncoated
PC10T	Carbide, TiCN coated	HC10T	HSS, TiCN coated
PC20T	Carbide, TiN coated	HC20T	HSS, TiN coated
PC30T	Carbide, TiAlN coated	HC20T	HSS, TiAlN coated
PC40T	Carbide, TiAlCrN coated		

Application examples

- **Workpiece** Mold
- **Cutting conditions** vc (m/min) = 57, fz (mm/t) = 0.03
 ap (mm) = 8, dry
- **Tools** EM16PM-080



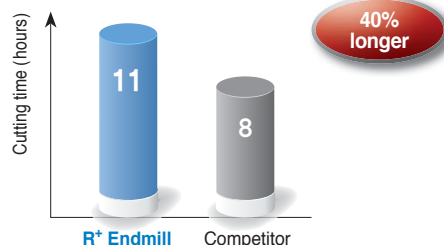
Test result



- **Workpiece** Mold
- **Cutting conditions** vc (m/min) = 2,700, fz (mm/t) = 0.06
 ap (mm) = 8, dry
- **Tools** EM43PM-080



Test result

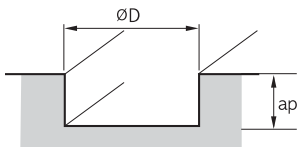


F Technical Information for R⁺ Endmill

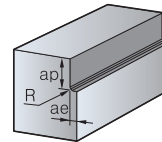
Recommended cutting conditions (EM09CA)

Workpiece Conditions Diameter (Ø)	Alloy steel, Carbon steel (≤ HRC25)		Alloy steel, Carbon steel, Pre-hardened steel (HRC25~HRC40)		Alloy steel, Carbon steel (≤ HRC25)		Alloy steel, Carbon steel, Pre-hardened steel (HRC25~HRC40)	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
6	12,000	1,090	10,600	770	15,800	1,800	14,300	1,300
8	9,000	1,160	8,100	830	11,900	1,890	10,700	1,370
10	7,200	1,160	6,400	830	9,500	1,890	8,500	1,370
12	6,000	1,080	5,400	800	8,000	1,800	7,100	1,300
14	5,200	1,080	4,750	770	7,000	1,760	6,250	1,260
16	4,500	1,080	4,100	740	6,000	1,720	5,400	1,230
18	4,400	1,000	3,650	680	5,400	1,610	4,850	1,140
20	3,600	930	3,200	630	4,800	1,500	4,300	1,050
25	3,200	840	2,800	600	4,400	1,400	3,800	980

Application tip



- Slotting depth (ap)
 - ap: ≤ 1.0D (≤ HRC25)
 - ap: ≤ 0.8D (HRC25~40)



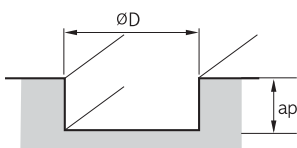
- Shouldering depth (ap)
 - ap: ≤ 1.0D
 - ae: ≤ 0.5D (≤ HRC25)
 - ae: ≤ 0.35D (HRC25~40)

* Workpiece should be clamped rigidly. In case of vibrations, reduce R.P.M and feed rate by the same ratio

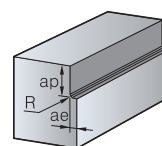
Recommended cutting conditions (EM09CA)

Workpiece Conditions Diameter (Ø)	Aluminum, Non-ferrous metal		Aluminum, Non-ferrous metal	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
6	13,000	1,125	13,000	1,400
8	10,400	1,300	10,400	1,600
10	10,400	1,585	10,400	2,000
12	10,400	1,950	10,400	1,650
14	7,800	1,675	7,800	2,050
16	7,800	1,755	7,800	2,250
18	5,200	1,300	5,200	1,700
20	5,200	1,495	5,200	1,800
25	5,000	1,495	5,000	1,800

Application tip



- Slotting depth (ap)
 - ap: ≤ 0.2D



- Shouldering depth (ap)
 - ap: ≤ 1.5D
 - ae: ≤ 0.15D

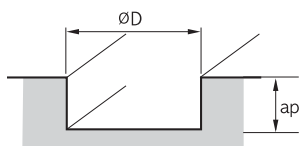
* Workpiece should be clamped rigidly. In case of vibrations, reduce R.P.M and feed rate by the same ratio



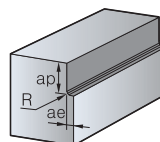
Recommended cutting conditions (EM36CA/EM43CA)

Workpiece Conditions Diameter (Ø)	Alloy steel, Carbon steel (≤ HRC25)		Alloy steel, Carbon steel, Pre-hardened steel (HRC25~HRC40)		Alloy steel, Carbon steel (≤ HRC25)		Alloy steel, Carbon steel, Pre-hardened steel (HRC25~HRC40)	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
6	12,000	1,550	10,600	1,100	15,800	2,570	14,300	1,850
8	9,000	1,650	8,100	1,180	11,900	2,700	10,700	1,950
10	7,200	1,650	6,400	1,180	9,500	2,700	8,500	1,950
12	6,000	1,540	5,400	1,140	8,000	2,570	7,100	1,850
14	5,200	1,540	4,750	1,095	7,000	2,510	6,250	1,800
16	4,500	1,540	4,100	1,050	6,000	2,450	5,400	1,750
18	4,400	1,435	3,650	975	5,400	2,295	4,850	1,625
20	3,600	1,330	3,200	900	4,800	2,140	4,300	1,500
25	3,200	1,200	2,800	850	4,400	2,000	3,800	1,400

Application tip



- Slotting depth (ap)
 - ap: ≤ 1.0D (≤ HRC25)
 - ≤ 0.8D (HRC25~40)



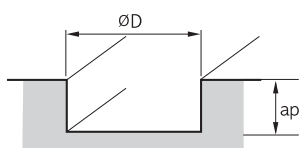
- Shouldering depth (ap)
 - ap: ≤ 1.0D
 - ae: ≤ 0.5D (≤ HRC25)
 - ≤ 0.35D (HRC25~40)

* Workpiece should be clamped rigidly. In case of vibrations, reduce R.P.M and feed rate by the same ratio

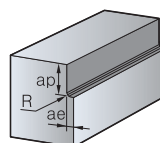
Recommended cutting conditions (EM37CA)

Workpiece Conditions Diameter (Ø)	Alloy steel, Carbon steel (≤ HRC35)		Pre-hardened steel (HRC35~HRC45)		High hardened steel (HRC45~HRC55)	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
6	12,400	840	8,400	570	3,400	260
8	9,200	840	6,300	570	2,400	240
10	7,600	840	5,100	570	2,000	290
12	6,000	840	4,200	570	1,680	260
14	5,200	840	3,600	570	1,400	200
16	4,800	760	3,300	510	1,200	160
18	4,400	720	2,700	420	1,100	150
20	3,600	560	2,400	360	1,000	150
25	3,200	620	2,160	410	900	160

Application tip



- Slotting depth (ap)
 - ap: ≤ 0.3D (≤ HRC45)
 - ≤ 0.05D (HRC45~55)



- Shouldering depth (ap)
 - ap: ≤ 1.0D
 - ae: ≤ 0.3D (≤ HRC45)
 - ≤ 0.05D (HRC45~55)

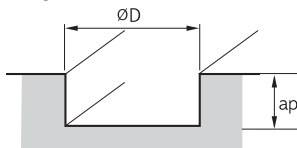
* Workpiece should be clamped rigidly. In case of vibrations, reduce R.P.M and feed rate by the same ratio

F Technical Information for R⁺ Endmill

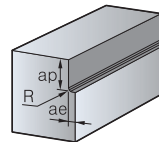
Recommended cutting conditions (EM38CA)

Workpiece Conditions Diameter (Ø)	Alloy steel, Carbon steel (≤ HRC25)		Alloy steel, Carbon steel, Pre-hardened steel (HRC25~HRC40)		Alloy steel, Carbon steel (≤ HRC25)		Alloy steel, Carbon steel, Pre-hardened steel (HRC25~HRC40)	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
6	12,000	1,240	10,600	800	15,800	2,060	14,300	1,480
8	9,000	1,320	8,100	940	11,900	2,160	10,700	1,560
10	7,200	1,320	6,400	940	9,500	2,160	8,500	1,560
12	6,000	1,230	5,400	910	8,000	2,060	7,100	1,480
14	5,200	1,230	4,750	880	7,000	2,010	6,250	1,440
16	4,500	1,230	4,100	840	6,000	1,960	5,400	1,400
18	4,400	1,150	3,650	780	5,400	1,840	4,850	1,300
20	3,600	1,060	3,200	720	4,800	1,710	4,300	1,200
25	3,200	960	2,800	680	4,400	1,600	3,800	1,120

Application tip



- Slotting depth (ap)
 - ap: ≤ 1.0D (≤ HRC25)
 - ≤ 0.8D (HRC25~40)



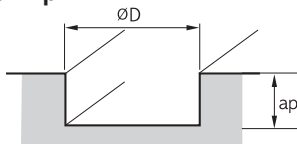
- Shouldering depth (ap)
 - ap: ≤ 1.0D
 - ae: ≤ 0.5D (≤ HRC25)
 - ≤ 0.35D (HRC25~40)

* Workpiece should be clamped rigidly. In case of vibrations, reduce R.P.M and feed rate by the same ratio

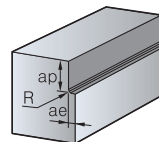
Recommended cutting conditions (EM06H9)

Workpiece Conditions Diameter (Ø)	Alloy steel, Carbon steel, High speed steel		Alloy steel, Carbon steel, High speed steel (≤ HRC20)		Alloy steel, Carbon steel, High speed steel (HRC20~HRC30)		Alloy steel, Carbon steel, High speed steel (HRC30~HRC40)	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
6	1,800	80	1,600	60	1,200	55	800	30
8	1,400	105	1,100	75	900	65	560	45
10	1,100	150	900	120	800	110	450	60
12	900	180	800	140	630	110	400	70
14	800	180	700	140	560	110	350	70
16	700	180	560	140	450	110	280	70
18	630	180	500	140	400	110	250	70
20	560	180	450	140	400	110	220	70
22	500	220	450	170	350	140	220	70
25	450	220	400	170	310	140	180	85
28	400	210	350	160	280	130	160	85
30	350	210	310	160	250	130	160	85
32	350	210	280	160	220	130	140	85
36	310	210	250	160	200	130	120	85
40	280	200	220	150	180	120	110	80
50	220	200	180	170	160	140	90	80

Application tip



- Slotting depth (ap)
 - ap: ≤ 0.15D



- Shouldering depth (ap)
 - ap: ≤ 1.5D
 - ae: ≤ 0.1D

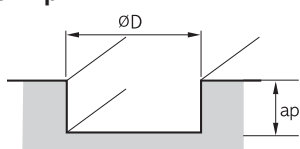
* Workpiece should be clamped rigidly. In case of vibrations, reduce R.P.M and feed rate by the same ratio



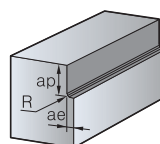
Recommended cutting conditions (EM17PM/EM16PM/EM11PM)

Workpiece Conditions Diameter (Ø)	Alloy steel, Carbon steel, High speed steel		Alloy steel, Carbon steel, High speed steel (≤ HRC20)		Alloy steel, Carbon steel, High speed steel (HRC20~HRC30)		Alloy steel, Carbon steel, High speed steel (HRC30~HRC40)	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
6	2,700	200	2,100	155	1,500	100	1,250	90
8	2,300	250	1,800	200	1,300	140	1,000	110
10	1,800	360	1,400	275	1,000	170	850	140
12	1,500	360	1,150	290	850	200	700	155
14	1,300	360	1,000	290	720	200	600	155
16	1,150	360	900	290	625	200	520	155
18	1,000	360	850	290	580	200	470	155
20	920	370	720	290	500	200	420	155
22	850	370	620	290	450	200	380	155
25	750	360	570	275	400	190	340	155

Application tip



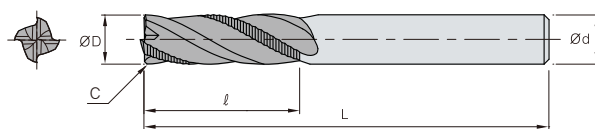
- Slotting depth (ap)
 - ap: ≤ 0.15D



- Shouldering depth (ap)
 - ap: ≤ 1.5D (All dia.)
 - ae: ≤ 0.5D (All dia.)

* Workpiece should be clamped rigidly. In case of vibrations, reduce R.P.M and feed rate by the same ratio

EM09CA (Roughing endmill with finishing capability)



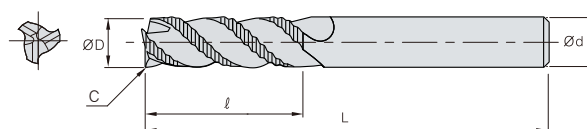
ØD	Tolerance
Ø6~Ø10	0.00~ -0.058
Ø10~Ø18	0.00~ -0.070
Ø18~Ø20	0.00~ -0.084



(mm)

Designation	ØD	Ød	ℓ	L	C
EM09CA-060	6.0	6	14	52	0.25
070	7.0	8	18	63	0.3
080	8.0	8	18	63	0.3
090	9.0	10	22	80	0.3
100	10.0	10	22	80	0.3
110	11.0	12	26	80	0.4
120	12.0	12	26	80	0.4
140	14.0	14	30	80	0.4
160	16.0	16	34	105	0.6
180	18.0	18	38	105	0.6
200	20.0	20	42	105	0.6

EM11CA (Roughing endmill for wave form of al)



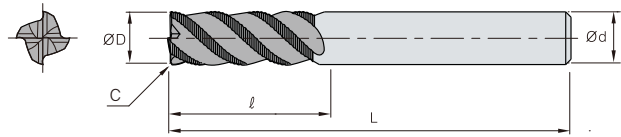
ØD	Tolerance
Ø6~Ø10	0.00~ -0.058
Ø10~Ø18	0.00~ -0.070
Ø18~Ø25	0.00~ -0.084



(mm)

Designation	ØD	Ød	ℓ	L	C
EM11CA-060	6.0	6	18	63	0.3
070	7.0	8	23	63	0.3
080	8.0	8	23	63	0.3
090	9.0	10	30	80	0.3
100	10.0	10	30	80	0.3
110	11.0	12	32	80	0.5
120	12.0	12	32	80	0.5
140	14.0	14	32	80	0.5
160	16.0	16	48	105	0.5
180	18.0	18	48	105	0.5
200	20.0	20	50	105	0.5
250	25.0	25	50	105	0.5



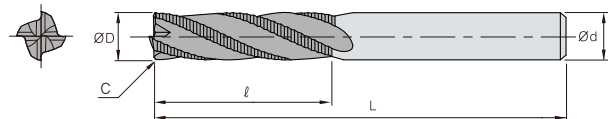
EM36CA (Long type roughing endmill for fine pitches)High helix angle,
irregular flute spacing and lead

ØD	Tolerance
Ø5~Ø20	0.00~ -0.05



(mm)

Designation		ØD	Ød	ℓ	L	C
 EM36CA–	050	5.0	6	19	63	0.3
	060	6.0	8	19	63	0.5
	080	8.0	8	28	72	0.5
	100	10.0	10	34	82	0.5
	120	12.0	12	40	97	0.5
	140	14.0	16	40	97	0.6
	160	16.0	16	48	108	0.6
	180	18.0	20	48	108	0.6
	200	20.0	20	56	122	0.6

EM37CA (Roughing endmill for fine pitches)

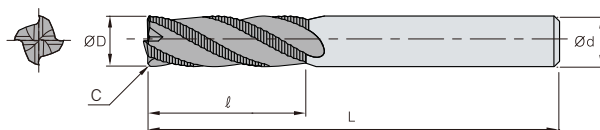
ØD	Tolerance
Ø5~Ø20	0.00~ -0.05



(mm)

Designation		ØD	Ød	ℓ	L	C
 EM37CA-	050	5.0	6	13	60	0.3
	060	6.0	8	13	80	0.5
	080	8.0	8	19	80	0.5
	100	10.0	10	22	80	0.5
	120	12.0	12	26	80	0.5
	140	14.0	16	26	85	0.6
	160	16.0	16	32	100	0.6
	180	18.0	20	32	100	0.6
	200	20.0	20	38	105	0.6

EM38CA (Standard roughing endmill)



ØD	Tolerance
Ø5~Ø20	0.00~ -0.05

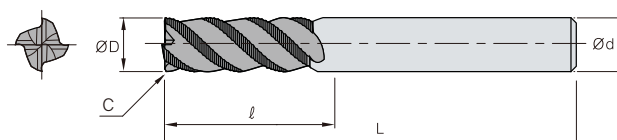


(mm)

Designation		ØD	Ød	ℓ	L	C
 EM38CA –	050	5.0	6	13	50	0.3
	060	6.0	6	16	50	0.3
	080	8.0	8	20	60	0.3
	100	10.0	10	25	75	0.3
	120	12.0	12	30	80	0.4
	140	14.0	16	35	100	0.6
	160	16.0	16	40	100	0.6
	180	18.0	20	40	110	0.6
	200	20.0	20	45	110	0.6

EM43CA (Standard roughing endmill for fine pitches)

High helix angle,
irregular flute spacing and lead

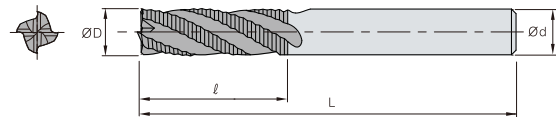


ØD	Tolerance
Ø5~Ø20	0.00~ -0.05



(mm)

Designation		ØD	Ød	ℓ	L	C
 EM43CA-4	050	5.0	6	13	57	0.3
	060	6.0	6	13	57	0.5
	080	8.0	8	19	63	0.5
	100	10.0	10	22	72	0.5
	120	12.0	12	26	82	0.5
	140	14.0	16	26	82	0.6
	160	16.0	16	32	92	0.6
	180	18.0	20	32	92	0.6
	200	20.0	20	38	104	0.6

EM11PM (Roughing endmill)

ØD	Tolerance
Ø6~Ø10	±0.075
Ø10~Ø18	±0.090
Ø18~Ø20	±0.105

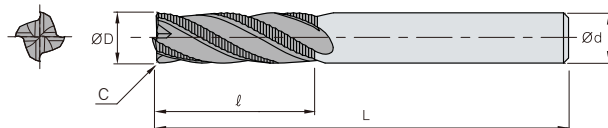


(mm)

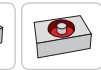
Designation		ØD	Ød	ℓ	L
 EM11PM-	060	6.0	6	20	60
	070	7.0	10	20	70
	080	8.0	10	25	75
	090	9.0	10	30	75
	100	10.0	10	35	85
	120	12.0	12	40	100
	140	14.0	16	40	100
	160	16.0	16	50	110
	180	18.0	20	50	110
	200	20.0	20	60	125

EM16PM (Roughing endmill for fine pitches)

Irregular flute spacing



ØD	Tolerance
Ø6~Ø10	±0.075
Ø10~Ø18	±0.090
Ø1~Ø20	±0.105

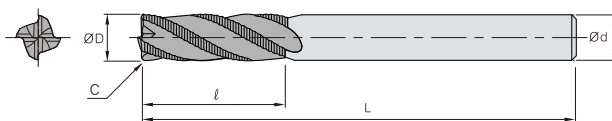


(mm)

Designation		ØD	Ød	ℓ	L	C
EM16PM- 4	060	6.0	6	20	60	0.5
	070	7.0	10	20	70	0.5
	080	8.0	10	25	75	0.5
	090	9.0	10	30	75	0.5
	100	10.0	10	35	85	0.5
	120	12.0	12	40	100	0.6
	140	14.0	12	40	100	0.6
	160	16.0	16	50	110	0.6
	180	18.0	16	50	110	0.6
	200	20.0	20	60	125	0.6

EM17PM (Roughing endmill for fine pitches)

Irregular flute spacing

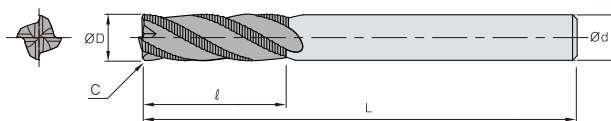


ØD	Tolerance
Ø6~Ø10	±0.075
Ø10~Ø18	±0.090
Ø18~Ø20	±0.105



(mm)

Designation	ØD	Ød	ℓ	L	C
EM17PM- 	060	6	13	80	0.5
	070	7	16	80	0.5
	080	8	19	85	0.5
	090	9	19	95	0.5
	100	10	22	100	0.5
	120	12	26	110	0.6
	140	14	26	110	0.6
	160	16	32	125	0.6
	180	18	32	125	0.6
	200	20	38	140	0.6

EM06H9M (Roughing endmill)

ØD	Tolerance
Ø6~Ø10	±0.075
Ø10~Ø18	±0.090
Ø18~Ø20	±0.105



(mm)

Designation	ØD	Ød	ℓ	L
EM06H9- 	060	6	15	60
	070	7	20	65
	080	8	20	65
	090	9	25	75
	100	10	25	75
	110	11	30	80
	120	12	30	80
	130	13	35	90
	140	14	35	90
	150	15	40	95
	160	16	40	95
	170	17	40	95
	180	18	40	105
	190	19	45	110
	200	20	45	110
	210	21	45	110
	220	22	45	110
	230	23	45	110
	240	24	50	120
	250	25	50	120
	260	26	50	120
	270	27	55	125
	280	28	55	125
	300	30	55	125
	320	32	60	145
	340	34	60	145
	350	35	60	145
	360	36	60	145
	380	38	65	150
	400	40	65	150
	420	42	65	155
	440	44	65	155
	450	45	70	160
	460	46	70	160
	500	50	70	160

F Technical Information for Solid Endmill for Aluminum

Good chip evacuation

Solid Endmills for Aluminum

- Minimum cutting load and built-up edge
- Good surface finish
- DLC coating
 - Higher hardness (Hv3000-7000), longer tool life comparing uncoated endmill
 - Excellent lubrication by low friction co-efficient ($\mu < 0.1$)
 - Good chip evacuation
- Superior in Aluminum, Aluminum alloys, Copper and Copper alloys

➤ Copper & aluminum machining

- Built-up edge
- Low heat resistance could create unnecessary stress or accuracy problem after machining
- Scratch due to low hardness
- Low tool life due to flank wear

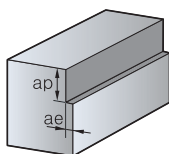
➤ Trouble shooting for copper & aluminum machining

- Use a higher rake, sharp edge, oil (MQL) mist to decrease cutting load and built-up edge
- Increase Vc and reduce the depth of cut for a better surface finish

➤ Recommended cutting condition (SSEA2000)

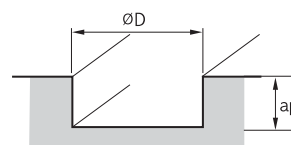
Workpiece Condition Diameter (Ø)	Shouldering				Slotting			
	Aluminum alloy (A7075)		Aluminum alloy (cast) (AC4B)		Aluminum alloy (A7075)		Aluminum alloy (cast) (AC4B)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
1	40,000	480	40,000	368	40,000	368	40,000	280
2	40,000	880	38,000	680	38,000	680	32,000	440
3	32,000	1,120	25,000	760	25,000	760	21,000	480
4	24,000	1,200	19,000	800	19,000	800	13,000	520
5	19,000	1,280	15,000	880	15,000	800	13,000	560
6	16,000	1,520	13,000	960	13,000	880	11,000	600
8	12,000	1,520	9,500	960	9,500	960	8,000	640
10	9,500	1,520	7,600	960	7,600	960	6,400	640
12	8,000	1,520	6,400	960	6,400	960	5,300	640
16	6,000	1,520	4,800	960	4,800	800	4,000	576
20	4,800	1,200	3,800	800	3,800	776	3,200	528

Application tip



■ Shouldering depth (ap) and radial depth (ae)

- $ae: \leq 0.2D$ ($D < \varnothing 3$)
- $\leq 0.5D$ ($D \geq \varnothing 3$)
- $ap: \leq 2.0D$

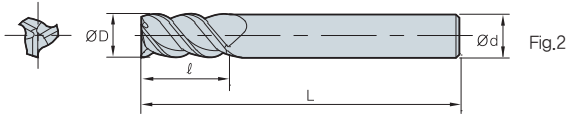
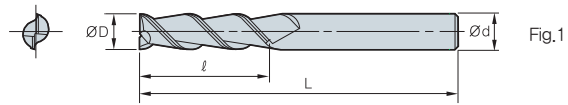


■ Slotting depth (ap)

- $ap: \leq D$ (max: 12mm)

* Workpiece should be clamped rigidly In case of vibrations, reduce R.P.M and feed rate by the same ratio



SSEA2000/3000 (Flat)

ØD	Tolerance
Ø1~Ø6	-0.010~-0.030
Ø7~Ø10	-0.015~-0.040
Ø11~Ø20	-0.020~-0.050

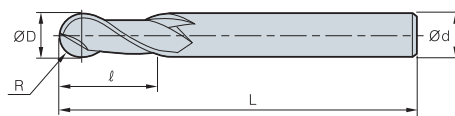
		(mm)				
Designation		ØD	Ød	ℓ	L	Fig.
SSEA 	2010	1	6	3	40	1
	2015	1.5	6	4	40	1
	2020	2	6	6	40	1
	2025	2.5	6	7	40	1
	2030	3	6	10	45	1
	2035	3.5	6	10	45	1
	2040	4	6	12	45	1
	2050	5	6	15	50	1
	2060	6	6	15	50	1
	2070	7	8	20	60	1
	2080	8	8	20	60	1
	2090	9	10	20	70	1
	2100	10	10	25	70	1
	2110	11	12	25	75	1
	2120	12	12	30	75	1
	2130	13	16	30	90	1
	2140	14	16	35	90	1
	2150	15	16	40	90	1
	2160	16	16	40	90	1
	2180	18	18	45	100	1
	2200	20	20	45	100	1
SSEA 	3020	2	6	6	40	2
	3030	3	6	10	45	2
	3035	3.5	6	10	45	2
	3040	4	6	12	45	2
	3050	5	6	15	50	2
	3060	6	6	15	50	2
	3070	7	8	20	60	2
	3080	8	8	20	60	2
	3090	9	10	20	70	2
	3100	10	10	25	70	2
	3110	11	12	25	75	2
	3120	12	12	30	75	2
	3130	13	16	30	90	2
	3140	14	16	35	90	2
	3150	15	16	40	90	2
	3160	16	16	40	90	2

Special endmills order: SSEA○○○○○I-L

Ex.1) 3 flutes, diameter: 6.3.I: 17, L: 60 SSEA3063 17-60L

Ex.2) 3 flutes, diameter: 6.3.standard type SSEA3063

SSBEA2000 (Ball)



ØD	Tolerance
All	0 ~ -0.03

(mm)

Designation	R	ØD	Ød	ℓ	L
SSBEA					
2010	0.5	1	6	3	70
2015	0.75	1.5	6	4	70
2020	1	2	6	6	70
2025	1.25	2.5	6	8	70
2030	1.5	3	6	10	70
2035	1.75	3.5	6	10	70
2040	2	4	6	12	70
2045	2.25	4.5	6	15	80
2050	2.5	5	6	15	80
2055	2.75	5.5	6	15	80
2060	3	6	6	15	80
2065	3.25	6.5	8	20	90
2070	3.5	7	8	20	90
2075	3.75	7.5	8	20	90
2080	4	8	8	20	90
2085	4.25	8.5	10	25	100
2090	4.5	9	10	25	100
2100	5	10	10	25	100
2110	5.5	11	12	30	110
2120	6	12	12	30	110
2130	6.5	13	16	35	120
2140	7	14	16	35	120
2150	7.5	15	16	40	120
2160	8	16	16	40	120
2170	8.5	17	20	40	130
2180	9	18	20	45	130
2190	9.5	19	20	45	130
2200	10	20	20	45	130

Special endmills order: SSBEA2000-L

Ex.1) 2 flutes, diameter: 6.3.I: 17, L: 60 SSBEA3063 17-60L

Ex.2) 2 flutes, diameter: 6.3.standard type SSBEA3063

Technique of machining copper/aluminum steel

- With high rake angle cutting edge, sharp tools and oil mist, able to minimize cutting load and built-up-edge
- Applying higher cutting speed and shallower depth, able to make surface finishing and productivity improved

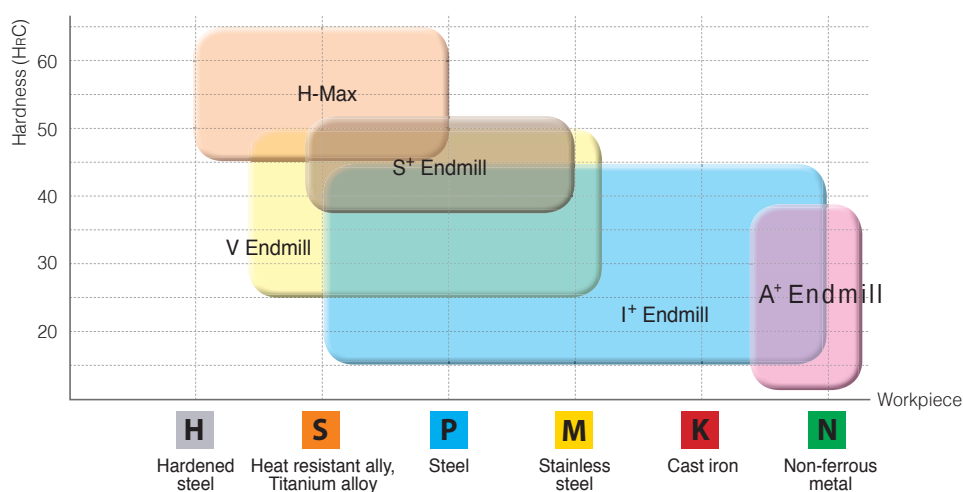


Aluminum Endmill

A⁺ Endmill

- Exclusive U-shaped flute
 - Excellent chip evacuation even in high feed machining
 - U shaped and buffed flute reduces built-up-edge
- Double relief angle
 - High rigidity of cutting edge ensures high productivity
- Sharp cutting edge
 - For both roughing and finishing (Shouldering, slotting and ramping etc.)

Application area



Performance evaluation

- **Workpiece** A7075
- **Cutting conditions** Diameter = Ø8.0, n (min⁻¹) = 8.000, vc (m/min) = 200, vf (mm/min) = 1.200, fz (mm/t) = 0.05, ap (mm) = 8, ae (mm) = 2.0, wet
- **Tools** APFE3080-060

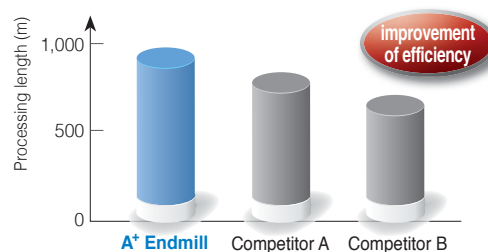


A⁺ Endmill

Competitor A

Competitor B

Test result

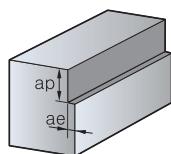


F Technical Information for A⁺ Endmill

Recommended cutting condition

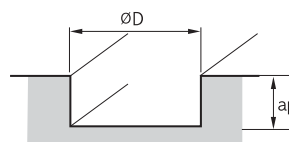
Workpiece Condition Diameter (Ø)	Shouldering				Slotting			
	Aluminum alloy (A7075)		Aluminum alloy (cast) (AC4B)		Aluminum alloy (A7075)		Aluminum alloy (cast) (AC4B)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
1	40,000	480	40,000	368	40,000	368	40,000	280
2	40,000	880	38,000	680	38,000	680	32,000	440
3	32,000	1,120	25,000	760	25,000	760	21,000	480
4	24,000	1,200	19,000	800	19,000	800	13,000	520
5	19,000	1,280	15,000	880	15,000	800	13,000	560
6	16,000	1,520	13,000	960	13,000	880	11,000	600
8	12,000	1,520	9,500	960	9,500	960	8,000	640
10	9,500	1,520	7,600	960	7,600	960	6,400	640
12	8,000	1,520	6,400	960	6,400	960	5,300	640
16	6,000	1,520	4,800	960	4,800	800	4,000	576
20	4,800	1,200	3,800	800	3,800	776	3,200	528

Application tip



Shouldering depth (ap) and radial depth (ae)

- ae: $\leq 0.2D$ ($D < \varnothing 3$)
 $\leq 0.5D$ ($D \geq \varnothing 3$)
- ap: $\leq 2.0D$



Slotting depth (ap)

- ap: $\leq D$ (max: 12 mm)

* Workpiece should be clamped rigidly In case of vibrations, reduce R.P.M and feed rate by the same ratio

Aluminum machining

- Built-up edge
- Low heat resistance could create residual stress or inaccuracy after machining
- Scratch due to low hardness
- Low tool life due to flank wear

Trouble shooting for aluminum machining

- Use a higher rake, sharp edge and oil (MQL) mist to decrease cutting load and built-up edge
- Increase Vc and reduce the depth of cut for better surface finish



APFE2000/3000 (Flat)

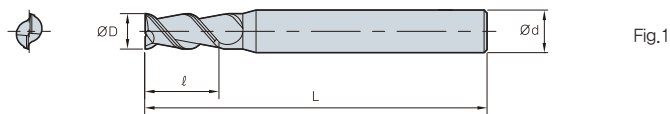


Fig.1

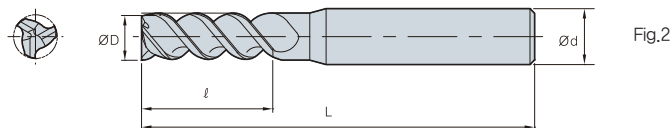


Fig.2



ØD	Tolerance
Ø1~Ø12	0.00~-0.02
Ø12.1~Ø20	0.00~-0.03

		(mm)				
Designation		ØD	Ød	ℓ	L	Fig.
APFE 2	2010-050-S6	1	6	3	50	1
	2015-050-S6	1.5	6	4	50	1
	2020-050-S4	2	4	6	50	1
	2025-050	2.2	6	8	50	1
	2030-050	3.0	6	9	50	1
	2040-050	4.0	6	12	50	1
	2050-050	5.0	6	15	50	1
	2060-050	6.0	6	18	50	1
	2080-060	8.0	8	20	60	1
	2100-075	10.0	10	30	75	1
	2120-075	12.0	12	32	75	1
	2160-100	16.0	16	45	100	1
	2200-100	20.0	20	45	100	1
APFE 3	3010-050-S4	1	4	3	50	2
	3015-050-S4	1.5	4	4	50	2
	3020-050-S4	2	4	6	50	2
	3025-050	2.5	6	8	50	2
	3030-050	3.0	6	9	50	2
	3040-050	4.0	6	12	50	2
	3050-050	5.0	6	15	50	2
	3060-050	6.0	6	18	50	2
	3080-060	8.0	8	20	60	2
	3100-075	10.0	10	30	75	2
	3120-075	12.0	12	32	75	2
	3160-100	16.0	16	45	100	2
	3200-100	20.0	20	45	100	2

APLFE2000/3000 (Long flat)

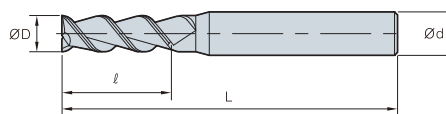


Fig.1

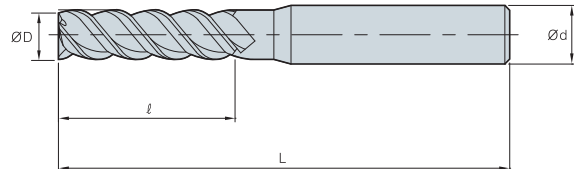


Fig.2



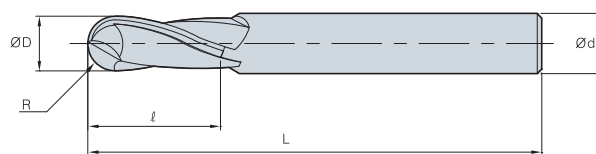
ØD	Tolerance
Ø1~Ø12	0.00~-0.02
Ø12.1~Ø20	0.00~-0.03

(mm)

Designation		ØD	Ød	ℓ	L	Fig.
APLFE 2	2030-060	3.0	6	12	60	1
	2040-060	4.0	6	16	60	1
	2050-060	5.0	6	20	60	1
	2060-075	6.0	6	25	75	1
	2080-075	8.0	8	32	75	1
	2100-100	10.0	10	45	100	1
	2120-100	12.0	12	45	100	1
	2160-150	16.0	16	65	150	1
	2200-150	20.0	20	75	150	1
APLFE 3	3030-060	3.0	6	12	60	2
	3040-060	4.0	6	16	60	2
	3050-060	5.0	6	20	60	2
	3060-075	6.0	6	25	75	2
	3080-075	8.0	8	32	75	2
	3100-100	10.0	10	45	100	2
	3120-100	12.0	12	45	100	2
	3160-150	16.0	16	65	150	2
	3200-150	20.0	20	75	150	2



APBE2000 (Ball)

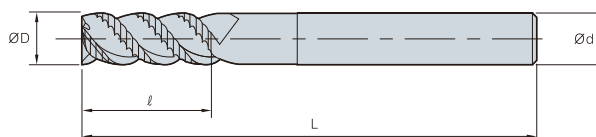


ØD	Tolerance
Ø1~Ø12	0.00~ -0.02

(mm)

Designation		ØD	Ød	ℓ	L
APBE 2	2010-050	1.0	4	2	50
	2015-050	1.5	4	3	50
	2020-050	2.0	4	4	50
	2025-050	2.5	4	5	50
	2030-050	3.0	4	6	50
	2035-050	3.5	4	7	50
	2040-050	4.0	4	8	50
	2045-050	4.5	6	9	50
	2050-050	5.0	6	10	50
	2055-050	5.5	6	11	50
	2060-050	6.0	6	12	50
	2080-060	8.0	8	16	60
	2100-075	10.0	10	20	75
	2120-075	12.0	12	24	75

APRE3000 (Roughing)



ØD	Tolerance
Ø1~Ø12	0.00~ -0.02

(mm)

Designation		ØD	Ød	ℓ	L
APRE 3	3040-050	4.0	6	8	50
	3050-050	5.0	6	13	50
	3060-050	6.0	6	15	50
	3065-060	6.5	8	16	60
	3070-060	7.0	8	16	60
	3075-060	7.5	8	20	60
	3080-060	8.0	8	20	60
	3085-075	8.5	10	20	75
	3090-075	9.0	10	20	75
	3095-075	9.5	10	22	75
	3100-075	10.0	10	25	75
	3110-075	11.0	12	30	75
	3120-075	12.0	12	30	75
	3130-075	13.0	14	30	75
	3140-075	14.0	16	32	75
	3150-075	15.0	16	32	75
	3160-100	16.0	16	35	100
	3170-100	17.0	20	35	100
	3180-100	18.0	20	35	100
	3200-100	20.0	20	45	100
	3250-105	25.0	25	50	105

F Technical Information for C-Max

(Copper)

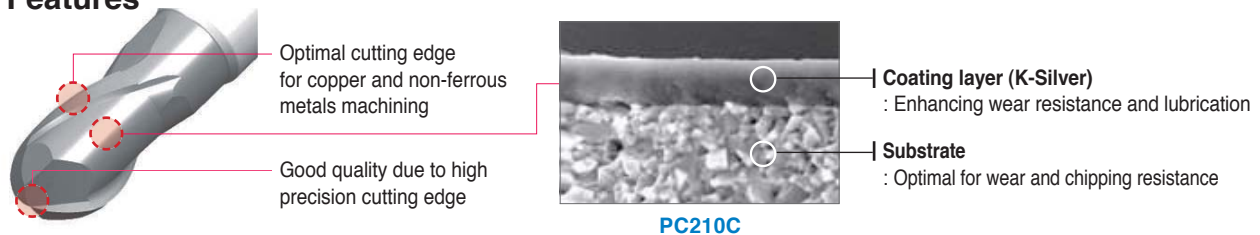
Long tool life and good surface roughness for electrode machining

C-Max

Copper

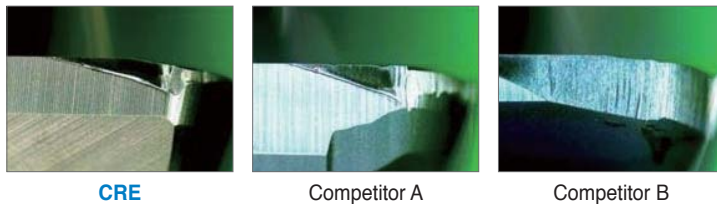
- Superior lubricity, wear resistance & chipping resistance due to the K-Silver coating layer and optimal substrate
- Optimal for copper and non-ferrous metal machining
- Wide line up (ball, flat, radius & long neck type)
- Long tool life and good surface roughness for electrode machining

Features

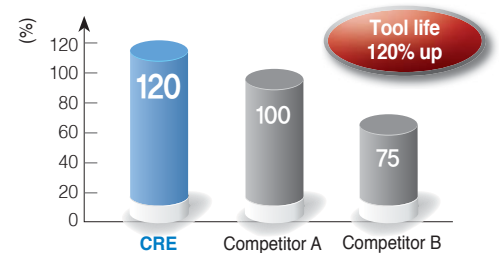


Application example

- Workpiece Cu, Electrode machining
- Cutting conditions vc (m/min) = 70, fz (mm/t) = 0.083, ap (mm) = 0.6, ae (mm) = 3.0
- Tools CRE4100-070-R10



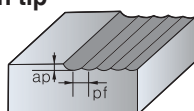
Test result



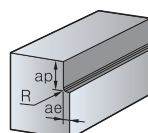
Recommended cutting condition

Workpiece	CBE/CBNE		CFE/CFNE		CRE/CRNE	
	Copper Alloys					
Condition Diameter (Ø)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
0.5	40,000	2,600	40,000	1,800	-	-
1	40,000	2,800	40,000	2,000	40,000	2,000
1.5	40,000	3,200	40,000	2,400	30,000	2,400
2	40,000	3,600	30,000	1,800	30,000	1,800
3	40,000	4,000	23,000	1,380	20,000	1,380
4	32,000	3,200	15,000	900	15,000	900
5	25,000	2,500	12,000	750	12,000	750
6	21,000	2,100	10,000	600	10,000	600
8	16,000	1,600	8,000	480	8,000	480
10	13,000	1,300	6,400	384	6,400	384
12	9,000	900	5,400	324	5,400	324

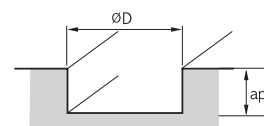
Application tip



- $ap = 0.1D$
- $pf = 0.2D$



- $ap = 1.5D$
- $ae = 0.1D$

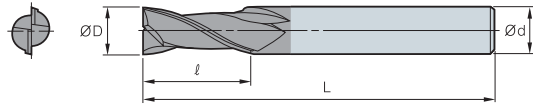


- $ap \leq 1.5D$

* Workpiece should be clamped rigidly. In case of vibrations, reduce R.P.M and feed rate by the same ratio



CFE2000 (Flat)

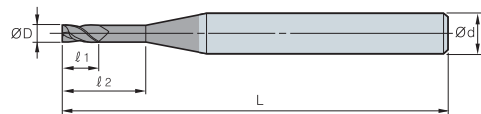


ØD	Tolerance
Ø0.5~Ø6	0.00~0.01
Ø8~Ø12	0.00~0.02

(mm)

Designation	ØD	Ød	ℓ	L
CFE				
2010-040	1	4	2.5	40
2015-040	1.5	4	4	40
2020-045	2	4	5	45
2030-045	3	6	8	45
2040-050	4	6	11	50
2050-060	5	6	13	60
2060-060	6	6	13	60
2080-060	8	8	19	60
2100-070	10	10	22	70
2120-075	12	12	26	75

CFNE2000 (Long neck flat)

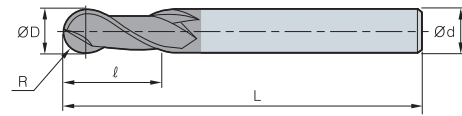


ØD	Tolerance
Ø0.5~Ø6	0.00~0.01
Ø8~Ø12	0.00~0.02

(mm)

Designation	ØD	Ød	ℓ₁	ℓ₂	L
CFNE					
2005-045-N2	0.5	4	0.8	2	45
2005-045-N4	0.5	4	0.8	4	45
2005-045-N6	0.5	4	0.8	6	45
2005-050-N8	0.5	4	0.8	8	50
2010-045-N4	1	4	1.5	4	45
2010-045-N6	1	4	1.5	6	45
2010-050-N8	1	4	1.5	8	50
2010-050-N10	1	4	1.5	10	50
2015-045-N6	1.5	4	2.3	6	45
2015-050-N8	1.5	4	2.3	8	50
2015-050-N10	1.5	4	2.3	10	50
2015-050-N12	1.5	4	2.3	12	50
2020-045-N6	2	4	3	6	45
2020-050-N8	2	4	3	8	50
2020-050-N10	2	4	3	10	50
2020-055-N12	2	4	3	12	50
2030-050-N10	3	4	4.5	10	50
2030-050-N12	3	4	4.5	12	50
2030-060-N14	3	4	4.5	14	60
2030-060-N16	3	4	4.5	16	60
2040-050-N12	4	6	6	12	50
2040-050-N16	4	6	6	16	50
2040-060-N20	4	6	6	20	60

CBE2000 (Ball)

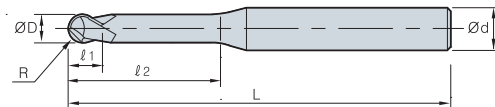


ØD	Tolerance	R Tolerance
Ø0.5~Ø6	0.00~0.01	±0.005
Ø8~Ø12	0.00~0.02	±0.005

(mm)

Designation	R	ØD	Ød	ℓ	L
CBE 2010-050	0.5	1	4	2.5	50
2015-050	0.75	1.5	4	4	50
2020-050	1	2	4	5	50
2030-060	1.2	3	6	8	60
2040-070	2	4	6	8	70
2050-080	2.5	5	6	10	80
2060-080	3	6	6	12	80
2080-090	4	8	8	14	90
2100-100	5	10	10	18	100
2120-110	6	12	12	22	110

CBNE2000 (Long neck ball)



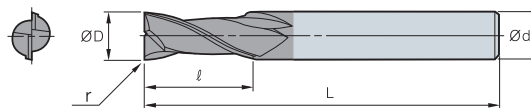
ØD	Tolerance
Ø0.5~Ø6	0.00~0.01
Ø8~Ø12	0.00~0.02

(mm)

Designation	R	ØD	Ød	ℓ ₁	ℓ ₂	L
CBNE 2005-045-N2	0.25	0.5	4	0.5	2	45
2005-045-N4	0.25	0.5	4	0.5	4	45
2005-045-N6	0.25	0.5	4	0.5	6	45
2005-050-N8	0.25	0.5	4	0.5	8	50
2010-045-N4	0.5	1	4	1	4	45
2010-045-N6	0.5	1	4	1	6	45
2010-050-N8	0.5	1	4	1	8	50
2010-050-N10	0.5	1	4	1	10	50
2015-050-N8	0.75	1.5	4	1.5	8	50
2015-050-N10	0.75	1.5	4	1.5	10	50
2015-050-N12	0.75	1.5	4	1.5	12	50
2015-055-N14	0.75	1.5	4	1.5	14	55
2020-050-N8	1	2	4	2	8	50
2020-050-N10	1	2	4	2	10	50
2020-050-N12	1	2	4	2	12	50
2020-055-N14	1	2	4	2	14	55
2030-050-N10	1.5	3	4	3	10	50
2030-050-N12	1.5	3	4	3	12	50
2030-055-N14	1.5	3	4	3	14	55
2030-055-N16	1.5	3	4	3	16	60
2040-060-N16	2	4	6	4	16	60
2040-060-N20	2	4	6	4	20	60
2040-070-N25	2	4	6	4	25	70
2040-070-N30	2	4	6	4	30	70



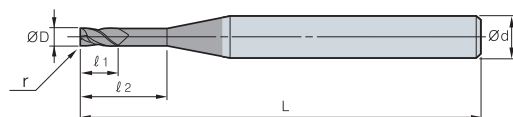
CRE2000 (Radius)



ØD	Tolerance	R Tolerance
Ø0.5~Ø6	0.00~0.01	±0.005
Ø8~Ø12	0.00~0.02	±0.005

Designation		r	ØD	Ød	ℓ	L
CRE 2	2020-045-R05	0.5	2	4	5	45
	2030-045-R05	0.5	3	6	8	45
	2040-050-R05	0.5	4	6	11	50
	2050-060-R05	0.5	5	6	13	60
	2060-060-R05	0.5	6	6	13	60
	2080-060-R10	1	8	8	19	60
	2100-070-R10	1	10	10	22	70
	2120-075-R10	1	12	12	26	75

CRNE2000 (Long neck radius)



ØD	Tolerance	R Tolerance
Ø0.5~Ø6	0.00~0.01	±0.005
Ø8~Ø12	0.00~0.02	±0.005

Designation		r	ØD	Ød	ℓ ₁	ℓ ₂	L
CRNE 2	2010-045-R02N4	0.2	1	4	1.5	4	45
	2010-045-R02N6	0.2	1	4	1.5	6	45
	2010-050-R02N8	0.2	1	4	1.5	8	50
	2010-050-R02N10	0.2	1	4	1.5	10	50
	2015-045-R02N6	0.2	1.5	4	2.3	6	45
	2015-050-R02N8	0.2	1.5	4	2.3	8	50
	2015-050-R02N10	0.2	1.5	4	2.3	10	50
	2015-050-R02N12	0.2	1.5	4	2.3	12	50
	2020-045-R05N6	0.5	2	4	3	6	45
	2020-050-R05N8	0.5	2	4	3	8	50
	2020-050-R05N10	0.5	2	4	3	10	50
	2020-055-R05N12	0.5	2	4	3	12	50
	2030-050-R05N10	0.5	3	4	4.5	10	50
	2030-050-R05N12	0.5	3	4	4.5	12	50
	2030-060-R05N14	0.5	3	4	4.5	14	60
	2030-060-R05N16	0.5	3	4	4.5	16	60
	2040-050-R05N12	0.5	4	6	6	12	50
	2040-050-R05N16	0.5	4	6	6	16	50
	2040-060-R05N20	0.5	4	6	6	20	60

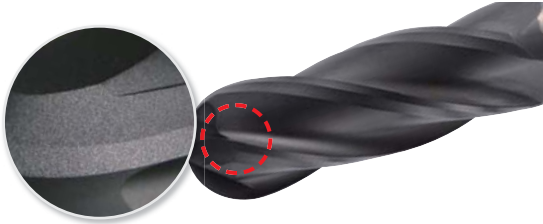
F Technical Information for D Endmill

Diamond coated endmill

D Endmill new

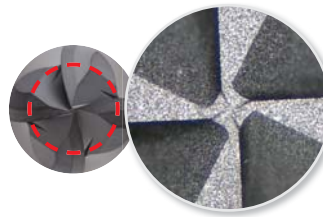
- Tangential cutting-edge geometries for excellent surface finish
- Excellent wear resistance due to high hardness and high purity diamond coating
- Advanced surface finish and cutting performance thanks to sharp edges and tangential tool geometries

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

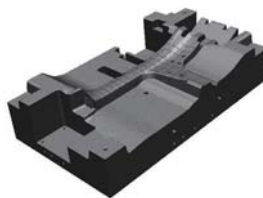


Center-matched ball shape (4-flutes)

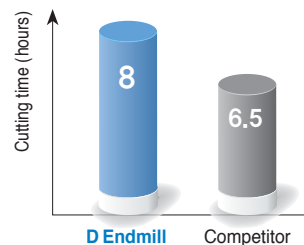
- Ball point shape for high feed machining
- Improved rigidity and excellent surface finish

Application examples

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

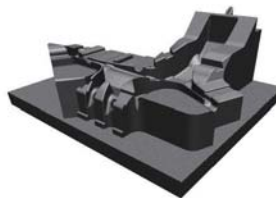


Test result

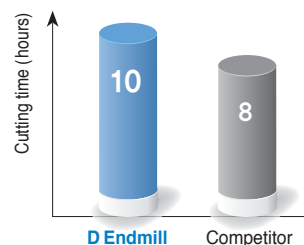


20% longer tool life

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



Test result

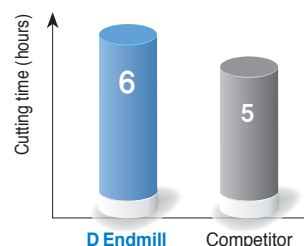


25% longer tool life

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



Test result



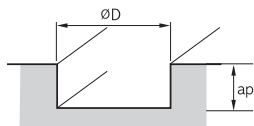
25% longer tool life



Recommended cutting conditions (Flat type)

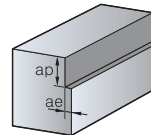
Tool	DFE2000 (Slotting)		DFE2000 (Shouldering)		DFE4000 (Shouldering)	
Workpiece	Graphite					
Conditions	R.P.M	Feed	R.P.M	Feed	RPM	Feed
Diameter (Ø)	n (min ⁻¹)	vf (mm/min)	n (min ⁻¹)	vf (mm/min)	n (min-1)	vf (mm/min)
1	40,000	500	40,000	700	-	-
2	25,000	570	25,000	800	25,000	1,600
3	20,000	570	20,000	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

Application tip



Slotting depth (ap)

- $D \leq \varnothing 2.5$, $ap = 0.3D$
- $D > \varnothing 2.5$, $ap = 0.5D$



Shouldering depth (ap)

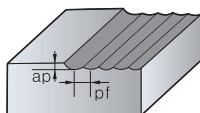
- $D \leq \varnothing 2.5$, $ap = 1.5D$, $ae = 0.05D$
- $D > \varnothing 2.5$, $ap = 1.5D$, $ae = 0.1D$

* Workpiece should be clamped rigidly In case of vibrations, reduce R.P.M and feed rate by the same ratio

Recommended cutting conditions (Ball type)

Tool	DBE2000		DBE4000	
Workpiece	Graphite			
Conditions				
Diameter (Ø)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
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

Application tip



Depth of cut (ap)

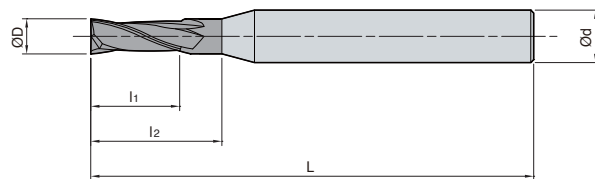
- $ap = 0.2D$
- $pf = 0.2D$

* Workpiece should be clamped rigidly In case of vibrations, reduce R.P.M 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)

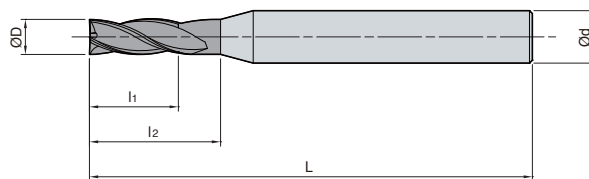


ØD	Tolerance
~Ø5.9	0.00~ -0.02
Ø6.0~	0.00~ -0.03

(mm)

Designation		ØD	Ød	l ₁	l ₂	L
DFE 2	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

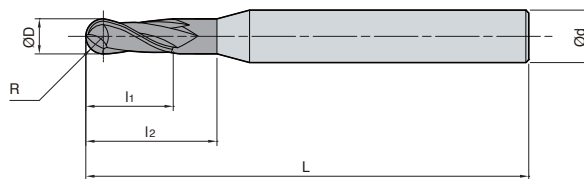


DFE4000 (Flat)

ØD	Tolerance
~Ø5.9	0.00~-0.02
Ø6.0~	0.00~-0.03

Designation		ØD	Ød	l ₁	l ₂	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)

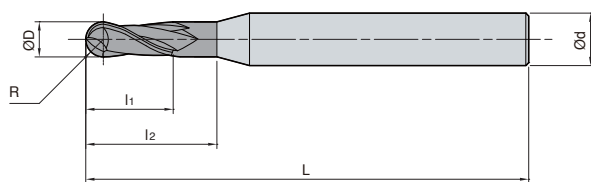


ØD	Tolerance
~Ø5.9	0.00~-0.02
Ø6.0~	0.00~-0.03

(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
2020-080-N400S04	1	2	4	6	40	80
2020-100-N450S04	1	2	4	6	45	100
2020-100-N500S04	1	2	4	6	50	100

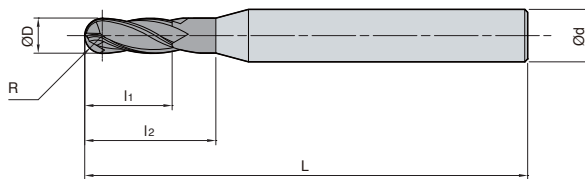


DBE2000 (Ball)

ØD	Tolerance
~Ø5.9	0.00~-0.02
Ø6.0~	0.00~-0.03

Designation		R	ØD	Ød	l ₁	l ₂	L	(mm)
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)



ØD	Tolerance
~Ø5.9	0.00~ -0.02
Ø6.0~	0.00~ -0.03

(mm)

Designation	R	ØD	Ød	l ₁	l ₂	L
DBE						
4 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



Router endmill for machining composite materials

Composite Router Endmill **new**

- Router endmills optimized for machining composite materials (CFRP/GFRP)
- Excellent tool life thanks to nano-crystal diamond coating
- Blade design for reducing flaking and burrs
- Improved productivity through high efficiency machining

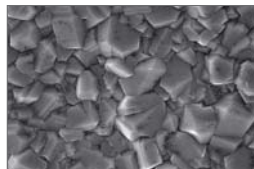
Features

- Diamond-coated grade ND2110 for machining composite materials
- High hardness diamond coating (over Hv 8,000)
- Nano-diamond coating with excellent resistance to friction and welding
- Improved resistance to flaking thanks by applying the specialized grade for diamond coating



Nano-diamond coating

Excellent
resistance
to friction



Existing diamond coating

CCR (Router Endmill)

- Down cut design for low vibrations and cutting force
- Endmill for roughing, profiling, and grooving



CCDR (Dual Helix Router Endmill)

- Dual helix design to inhibit flaking on upper and lower faces of workpieces
- Endmill for finishing, profiling, and grooving



CCLR (Low Helix Router Endmill)

- Fewer burrs thanks to the low axial cutting force
- Endmill for finishing, profiling, and blind groove making



CCRR (Reverse Helix Router Endmill)

- Reverse helix design to inhibit a drift in the workpiece's course
- Endmill for finishing, profiling, and through groove making



CCDR4000/6000 (Flat)

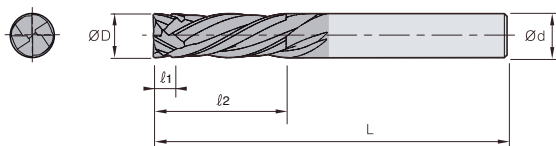


Fig.1

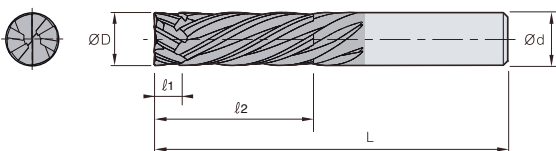


Fig.2



ØD	Tolerance
Ø6~12	0.00~ -0.03 (mm)

(mm)

Designation		ØD	Ød	l ₁	l ₂	L	Fig.
CCDR 4	4060-065	6	6	3	18	65	1
	4080-075	8	8	4	24	75	1
CCDR 6	6100-085	10	10	5	30	85	2
	6120-100	12	12	6	36	100	2

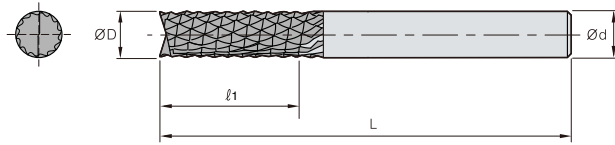


ØD	Tolerance
Ø0.250~0.500	0.0000~ -0.0012 (inch)

(inch)

Designation		ØD	Ød	l ₁	l ₂	L	Fig.
CCDR 4	402500	1/4 0.250	0.250	0.125	0.750	2.500	1
	402500L	1/4 0.250	0.250	0.125	1.500	4.000	1
CCDR 6	603750	3/8 0.375	0.375	0.125	1.000	3.250	2
	603750L	3/8 0.375	0.375	0.125	1.500	4.000	2
	605000	1/2 0.500	0.500	0.125	1.000	3.250	2
	605000L	1/2 0.500	0.500	0.125	1.500	4.000	2

CCR2000 (Flat)



ØD	Tolerance
Ø4~12	-0.02~-0.08 (mm)

Designation		ØD	Ød	l ₁	L
CCR 2	2040-050	4	4	12	50
	2050-050	5	5	15	50
	2060-065	6	6	18	65
	2080-075	8	8	24	75
	2100-065	10	10	30	85
	2120-065	12	12	36	100

(mm)

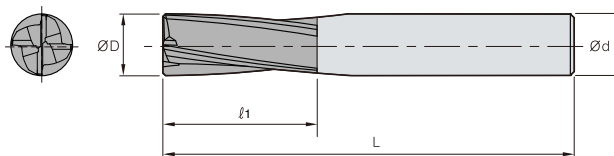


ØD	Tolerance
Ø0.250~0.500	-0.0008~-0.0032 (inch)

Designation		ØD	Ød	l ₁	L
CCR 2	202500	1/4 0.250	0.250	0.750	2.500
	202500L	1/4 0.250	0.250	1.500	4.000
	203750	3/8 0.375	0.375	1.000	3.250
	203750L	3/8 0.375	0.375	1.500	4.000
	205000	1/2 0.500	0.500	1.000	3.250
	205000L	1/2 0.500	0.500	1.500	4.000

(inch)

CCLR4000 (Flat)



ØD	Tolerance
Ø4~12	0.00~ -0.03 (mm)

(mm)

Designation	ØD	Ød	ℓ1	L
CCLR 4040-050	4	4	12	50
4050-050	5	5	15	50
4060-065	6	6	18	65
4080-075	8	8	24	75
4100-085	10	10	30	85
4120-100	12	12	36	100



ØD	Tolerance
Ø0.250~0.500	0.0000~ -0.0012 (inch)

(inch)

Designation	ØD	Ød	ℓ1	L
CCLR 402500	1/4 0.250	0.250	0.750	2.500
402500L	1/4 0.250	0.250	1.500	4.000
403750	3/8 0.375	0.375	1.000	3.250
403750L	3/8 0.375	0.375	1.500	4.000
405000	1/2 0.500	0.500	1.000	3.250
405000L	1/2 0.500	0.500	1.500	4.000

CCRR6000/8000 (Flat)

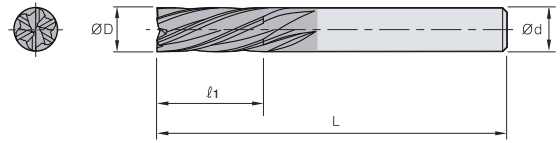


Fig.1

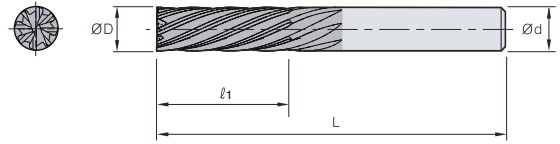


Fig.2



ØD	Tolerance
Ø6~12	0.00~-0.03 (mm)

(mm)

Designation		ØD	Ød	ℓ ₁	L	Fig.
CCRR 6	6060-065	6	6	18	65	1
	6080-075	8	8	24	75	1
CCRR 8	8100-085	10	10	30	85	2
	8120-100	12	12	36	100	2



ØD	Tolerance
Ø0.250~0.500	0.0000~-0.0012 (inch)

(inch)

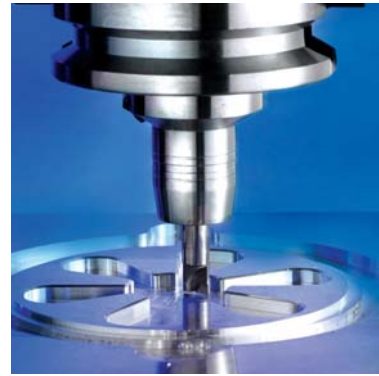
Designation		ØD	Ød	ℓ ₁	L	Fig.
CCRR 6	602500	1/4 0.250	0.250	0.750	2.500	1
	602500L	1/4 0.250	0.250	1.500	4.000	1
CCRR 8	803750	3/8 0.375	0.375	1.000	3.250	2
	803750L	3/8 0.375	0.375	1.500	4.000	2
	805000	1/2 0.500	0.500	1.000	3.250	2
	805000L	1/2 0.500	0.500	1.500	4.000	2

F Technical Information for PCD Endmill

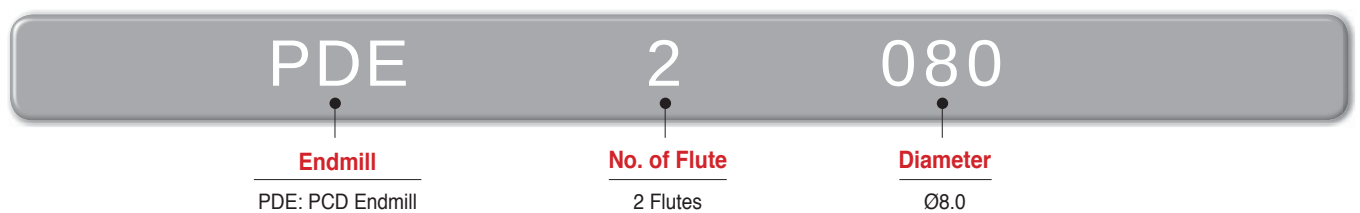
Longer tool life and good surface finishes

PCD Endmill

- Longer tool life and good surface roughness
- Reducing burrs at non-ferrous metals machining
- 1000 type: Ultra finishing for non-ferrous metals
- 2000 type: Optimal for aluminum alloy, carbon steel, graphite and reinforced Plastic machining



PCD endmill code system



Recommended cutting condition

Workpiece	vc (m/min)	n (min ⁻¹)	fz (mm/t)
Aluminum Alloy, Copper	30~300	2,000~12,000	0.02~0.07
Reinforced Plastic	35~300	2,800~16,000	0.04~0.12
Carbon steel, Graphite	10~100	5,300~16,000	0.04~0.2

Special endmill order form

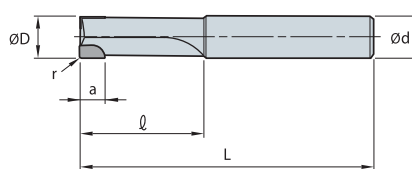


Fig.1

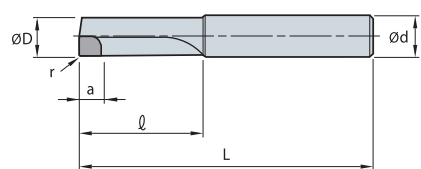


Fig.2

Designation	Fig.	No. of Flute	Dimension (mm)					
			ØD	Ød	r	a	ℓ	L
PDES								

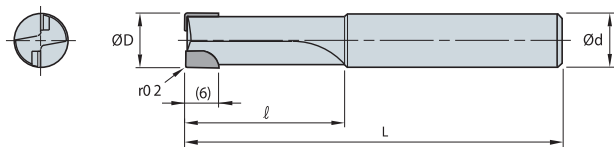
※ Depending on customer requests, we can make special Endmill



F

Endmills

PDE1000/2000 (Flat)



1

2

H-A
0°

PCD

Substrate
DP200

		(mm)			
Designation		ØD	Ød	ℓ	L
PDE 1	1040	4	6	15	45
	1050	5	6	15	50
	1060	6	6	20	60
PDE 2	2060	6	8	20	60
	2070	7	8	20	60
	2080	8	8	20	60
	2090	9	10	25	70
	2100	10	10	25	70
	2120	12	12	25	75

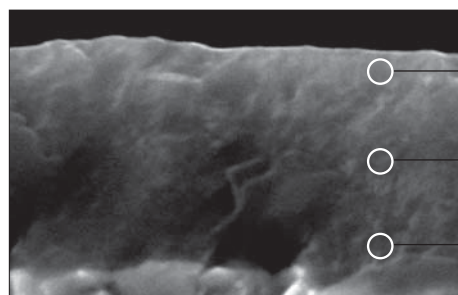
F Technical Information for Brazed Endmill

High precision machining with our high stiffness design

Brazed Endmills

- Possible to machine with high precision due to high stiffness design
- High speed cutting by increasing wear resistance, decreasing frictional resistance through PVD coating and substrate
- Long tool life due to absorbing impact through brazed body in heavy interruption
- General steel, Alloy steel, mild steel, dice steel, stainless steel, cast iron, ductile cast iron
- ZSEA: Aluminum, Aluminum alloy, Copper, Copper alloy, Non-ferrous materials
- Coating brazed endmills (special) – Guaranteed long tool life due to high new-concept hardness and oxidation resistant coating

Features



PC221F Coating

- Top layer
Improvement of hardness and oxidation resistance
- Main layer
Improvement of adhesion and chipping resistance
- Ultra fine substrate

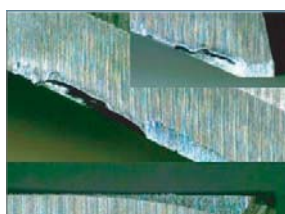
Brazed Endmills code system

Z	S	E	2	14	-	S
Brazed	Spiral	Endmill	No. of flutes	Diameter		Shank dia.
		E: Flat (Steel) EA: Flat (Al, Cu) EL: Flat Long (Steel) EXL: Flat Long (Steel) BE: Ball (Steel)	2: 2 Flutes 3: 3 Flutes	Ø14		S: Ø42.0 Q: Coated SQ: Ø42.0 Coated Standard Shank Diameter: none

Wear resistance test



Coated ZSE(PC221F)



Carbide ZSE

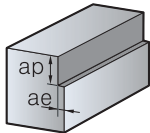
Double
tool life



Recommended cutting conditions (ZSE200 flat)

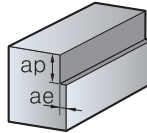
Workpiece Condition Diameter (Ø)	SM50C,SCM,GC (~HRC30)		STD61,STD11 (HRC30~45)		STD61 (HRC45~55)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
20	1,600	152	950	88	560	44
25	1,300	136	750	72	450	36
30	1,100	120	650	64	370	32
40	800	96	500	56	280	24
50	650	88	400	48	220	20

Application tip



Side milling (under HRC45)

- ap: ≤ 1.5D
- ae: ≤ 0.1D



Side milling (over HRC45)

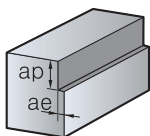
- ap: ≤ 1D (Max: 1mm)

※ Above table based on side milling, when it enters to ae direction, you should apply reduced cutting condition
 ※ When it enters to ae direction, for finishing you should increase revolution speed and feed in the table

Recommended cutting conditions (ZSE400 flat)

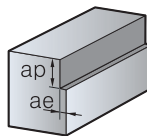
Workpiece Condition Diameter (Ø)	SM50C,SCM,GC (~HRC30)		STD61,STD11 (HRC30~45)		STD61 (HRC45~55)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
20	1,600	230	950	133	560	66
25	1,300	205	750	109	450	54
30	1,100	180	650	96	370	48
40	800	145	500	85	280	36
50	650	135	400	72	220	30

Application tip



Side milling (under HRC45)

- ap: ≤ 1.5D
- ae: ≤ 0.1D

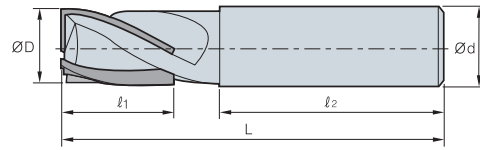
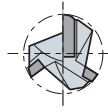


Side milling (over HRC45)

- ap: ≤ 1D (Max: 1mm)

※ Above table based on side milling, when it enters to ae direction, you should apply reduced cutting condition
 ※ When it enters to ae direction, for finishing you should increase revolution speed and feed in the table

ZSE200/300 (Flat)



ØD	Tolerance
All	0.00~-0.05

(mm)

Designation	ØD	Ød	l ₁	l ₂	L
ZSE					
214	14	16	28	57	95
215	15	16	28	57	95
216(Q)	16	16	28	55	95
217	17	20	30	70	115
218	18	20	30	70	115
219	19	20	30	70	115
220(Q)	20	20	30	70	115
221	21	20	35	65	115
222	22	20	35	65	115
223	23	25	35	75	125
224	24	25	35	75	125
225	25	25	35	75	125
226(Q)	26	25	35	75	125
227	27	25	35	75	125
228	28	25	35	75	125
229	29	32	40	95	150
230(Q)	30	32	40	95	150
231	31	32	40	95	150
232	32	32	45	90	150
233	33	32	45	90	150
234	34	32	50	85	150
235	35	32	50	85	150
236	36	32	50	85	150
237	37	32	55	80	150
238	38	32	55	80	150
238S	38	42	55	80	150
240(Q)	40	32	60	75	150
240S	40	42	60	75	150
242	42	32	60	75	150
244	44	32	65	80	160
245	45	32	65	80	160
245S	45	42	65	80	160
247	47	32	65	80	160
248	48	32	65	80	160
248S	48	42	65	80	160
250	50	32	65	80	160
250S	50	42	65	80	160
ZSE					
314	14	16	28	57	95
315	15	16	28	57	95
316	16	16	28	55	95
317	17	20	30	70	115
318	18	20	30	70	115
319	19	20	30	70	115
320	20	20	30	70	115
322	22	20	35	65	115
325	25	25	35	75	125
326	26	25	35	75	125
328	28	25	35	75	125
330	30	32	40	95	150
331	31	32	40	95	150

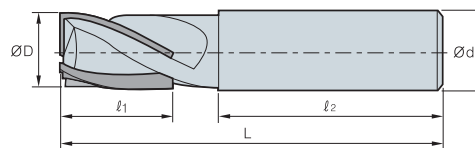
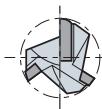
Special Endmills order: ZSE○○○○○-L

Ex.1) 2 flutes, diameter: 6.3, l: 10, L: 60 ZSBE2063 10-60L

Ex.2) 2 flutes, diameter: 6.3, standard type ZSE2063



ZSE300/400/600 (Flat)



ØD	Tolerance
All	0.00~-0.05

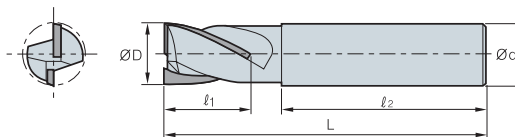
Designation		ØD	Ød	ℓ ₁	ℓ ₂	L
ZSE 3	332	32	32	45	90	150
	333	33	32	45	90	150
	334	34	32	50	85	150
	335	35	32	50	85	150
	338	38	32	55	80	150
	338S	38	42	55	80	150
	340	40	32	60	75	150
	340S	40	42	60	75	150
	342	42	32	60	75	150
	345	45	32	65	80	160
	345S	45	42	65	80	160
	350	50	32	65	80	160
	350S	50	42	65	80	160
ZSE 4	414	14	16	28	57	95
	415	15	16	28	57	95
	416(Q)	16	16	28	55	95
	417	17	20	30	70	115
	418	18	20	30	70	115
	419	19	20	30	70	115
	420(Q)	20	20	30	70	115
	421	21	20	35	65	115
	422	22	20	35	65	115
	423	23	25	35	75	125
	424	24	25	35	75	125
	425(Q)	25	25	35	75	125
	426	26	25	35	75	125
	427	27	25	35	75	125
	428	28	25	35	75	125
	429	29	32	40	95	150
	430	30	32	40	95	150
	432(Q)	32	32	45	90	150
	435	35	32	50	80	150
	438	38	32	55	85	150
	438S	38	42	55	85	150
	440(Q)	40	32	60	75	150
	440S	40	42	60	75	150
	445	45	32	65	80	160
	445S	45	42	65	80	160
	450	50	32	65	80	160
	450S	50	42	65	80	160
ZSE 6	634	34	32	50	85	150
	635	35	32	50	85	150
	638	38	32	55	80	150
	638S	38	42	55	80	150
	640	40	32	60	75	150
	640S	40	42	60	75	150
	645	45	32	65	80	160
	645S	45	42	65	80	160
	650	50	32	65	80	160
	650S	50	42	65	80	160

Special Endmills order: ZSE○○○○○-L

Ex.1) 2 flutes, diameter: 6.3, l: 10, L: 60 ZSBE2063 10-60L

Ex.2) 2 flutes, diameter: 6.3, standard type ZSE2063

ZSEA200 (Flat)



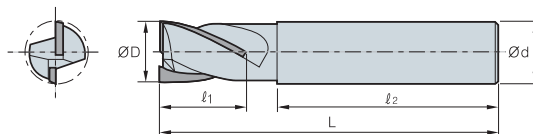
ØD	Tolerance
All	0.00~ -0.05

(mm)

Designation	ØD	Ød	ℓ ₁	ℓ ₂	L
ZSEA					
215	15	16	28	57	95
216	16	16	28	55	95
218	18	20	30	70	115
219	19	20	30	70	115
220	20	20	30	70	115
221	21	20	35	65	115
222	22	20	35	65	115
223	23	25	35	75	125
224	24	25	35	75	125
225	25	25	35	75	125
228	28	25	35	75	125
230	30	32	40	95	150
232	32	32	45	90	150
238	38	32	55	80	150
240	40	32	60	75	150
250	50	32	65	80	160



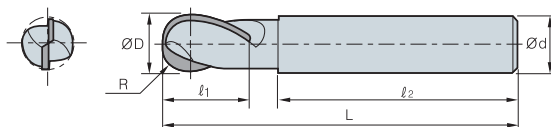
ZSEL200/400, ZSEXL200 (Long flat)



ØD	Tolerance
All	0.00~ -0.05

Designation		ØD	Ød	ℓ ₁	ℓ ₂	L
(mm)						
ZSEL 2	214	14	16	50	55	120
	216	16	16	50	55	120
	218	18	20	60	65	140
	220	20	20	60	65	140
	222	22	20	60	65	140
	225	25	25	70	65	150
	230	30	32	80	85	180
	232	32	32	90	85	190
	235	35	32	100	85	200
	240	40	42	100	105	220
	245	45	42	120	95	230
	250	50	42	120	95	230
ZSEL 4	416	16	16	50	55	120
	420	20	20	60	65	140
	425	25	25	70	65	150
	430	30	32	80	85	180
	435	35	32	100	85	200
	440	40	42	100	105	220
ZSEXL 2	220	20	20	120	65	200
	222	22	20	120	65	200
	225	25	25	140	65	220

ZSBE200 (Ball)



ØD	Tolerance
All	0.00~ -0.05

Designation		R	ØD	Ød	ℓ ₁	ℓ ₂	L (mm)
ZSBE	213	6.5	13	16	30	60	100
	214	7	14	16	30	65	100
	215	7.5	15	16	35	55	100
	216Q	8	16	16	35	55	100
	217	8.5	17	20	35	65	110
	218	9	18	20	35	65	110
	219	9.5	19	20	35	65	110
	220Q	10	20	20	35	65	110
	221	10.5	21	20	35	65	110
	222	11	22	20	35	65	110
	223	11.5	23	25	40	65	120
	224	12	24	25	40	70	120
	225	12.5	25	25	40	70	120
	230	15	30	32	40	70	130
	231	15.5	31	32	40	80	130
	232	16	32	32	50	75	140
	233	16.5	33	32	50	75	140
	234	17	34	32	50	85	150
	235	17.5	35	32	50	85	150
	235S	17.5	35	42	50	85	150
	236	18	36	32	50	85	150
	236S	18	36	42	50	85	150
	237	18.5	37	32	50	95	160
	237S	18.5	37	42	50	95	160
	238	19	38	32	50	95	160
	238S	19	38	42	50	95	160
	239	19.5	39	32	50	95	160
	239S	19.5	39	42	50	95	160
	240	20	40	32	50	95	160
	240S	20	40	42	50	95	160
	245	22.5	45	32	50	105	170
	245S	22.5	45	42	50	105	170
	250	25	50	32	50	105	170
	250S	25	50	42	50	105	170

• ZSBE200

Special Endmills order: ZSBE200-I-L

Ex.1) 2 flutes diameter: 6.3 I: 10 L: 60 ZSBE 206310-60L

Ex.2) 2 flutes, diameter: 6.3, standard type ZSBE2063

• ZSEA200

Special Endmills order : ZSEA200-I-L

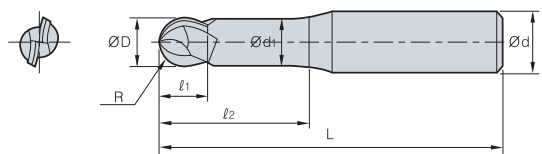
Ex.1) 2 flutes, diameter: 16.3, I: 28, L: 95 ZSEA2163 28-95L

Ex.2) 2 flutes, diameter: 17.0, standard type ZSEA2170

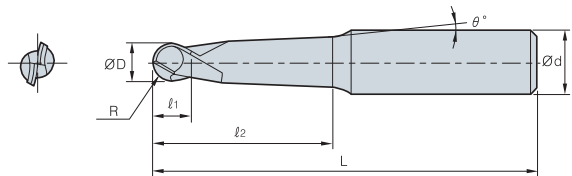
• ZSEL200/400, ZSEXL200

Special Endmills orde r: ZSEL200-I-L

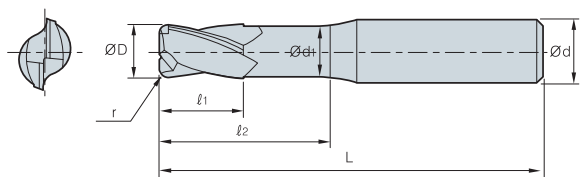




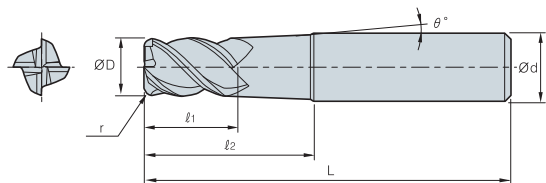
Designation	Flute	R	ØD	Ød	Ød ₁	l ₁	l ₂	L



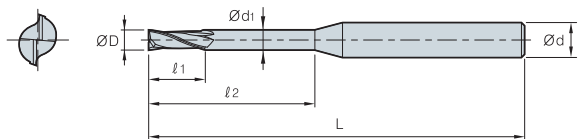
Designation	Flute	R	ØD	Ød	l ₁	l ₂	L	θ°



Designation	Flute	ØD	Ød	Ød ₁	r	l ₁	l ₂	L



Designation	Flute	ØD	r	Ød	l ₁	l ₂	L	θ°



Designation	Flute	ØD	Ød	Ød ₁	l ₁	l ₂	L