

F

ENDMILLS

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



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Solid Endmills

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Solid Endmills

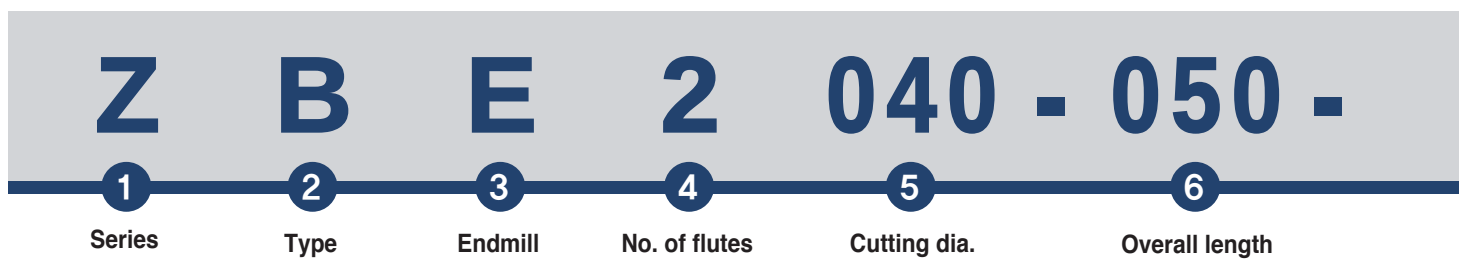
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Brazed Endmills

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Special Endmill order Form

- F123** Special Endmill Order Form



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

Z, IP, ZP: Endmill for general usage
P: High speed/ hardness Endmill
C: Copper, Copper alloy Endmill
D: Graphite, Non-Ferrous Endmill
V: Variable Endmill
FM: High feed Endmill

SSEA, AP: Aluminum Endmill
SP: Stainless Endmill
CC: Composite Router 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 (Aluminum Endmill) and ZSE (Brazing Endmill)

R02 T00 - V05 N12 S06**7**

Corner radius

8

Taper angle

9

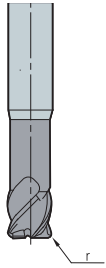
Flute length

10

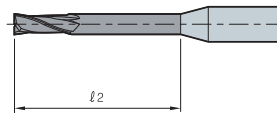
Neck length

11

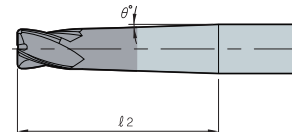
Shank diameter

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

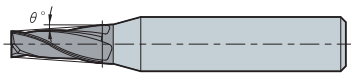


Taper Long Neck

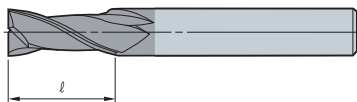
 l_2 (mm): Neck LengthT (θ°): Taper Angle

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 S**T (θ°): Taper Angle

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

9**Flute 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	Grade	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 resistance 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	High feed	FME4000	PC203F		○	High speed High hardness	4	6	12	○		○		◎	◎	F26
	High feed 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
D Endmill new	Flat	DFE2000	ND3000		○	Graphite, Ceramics	2	1	12				◎			F32
		DFE4000	ND3000		○	Graphite, Ceramics	4	2	12				◎			F33
	Ball	DBE2000	ND3000		○	Graphite, Ceramics	2	0.6	12				◎			F34 F35
		DBE4000	ND3000		○	Graphite, Ceramics	4	2	12				◎			F36

◎: Excellent ○: Good



Type	Shape	Designation	Grade	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	
Solid Endmills for aluminum	Flat	SSEA2000	H01 PD3000		— (○)	Aluminum	2	1	20	○			◎			F38
	Flat	SSEA3000	H01 PD3000		— (○)	Aluminum	3	2	16	○			◎			F38
	Ball	SSBEA2000	H01 PD3000		— (○)	Aluminum	2	1	20	○			◎			F39
C-Max	Flat	CFE2000	PC210C		○	Copper, Copper alloy	2	1	12	○			◎			F41
	Long neck flat	CFNE2000	PC210C		○	Copper, Copper alloy	2	0.5	4	○			◎			F41
	Ball	CBE2000	PC210C		○	Copper, Copper alloy	2	1	12	○			◎			F42
	Long neck ball	CBNE2000	PC210C		○	Copper, Copper alloy	2	0.5	4	○			◎			F42
	Radius	CRE2000	PC210C		○	Copper, Copper alloy	2	2	12	○			◎			F43
	Long neck radius	CRNE2000	PC210C		○	Copper, Copper alloy	2	1	4	○			◎			F43
new Super Endmill	Radius	SRES4000	SL		○	HRSA	4	3	20					◎		F46~ F50
new Composite Router Endmill	Flat	CCDR4000	ND2100		○	Composite CFRP, GFRP	4	6	8				◎			F52
		CCDR6000	ND2100		○	Composite CFRP, GFRP	6	10	12				◎			F52
		CCHR4000	ND2100		○	Composite CFRP, GFRP	4	6	8				◎			F53
		CCHR6000	ND2100		○	Composite CFRP, GFRP	6	10	12				◎			F53
		CCR2000	ND2100		○	Composite CFRP, GFRP	2	4	12				◎			F54
		CCLR4000	ND2100		○	Composite CFRP, GFRP	4	4	12				◎			F55
		CCRR6000	ND2100		○	Composite CFRP, GFRP	6	6	8				◎			F56
		CCRR8000	ND2100		○	Composite CFRP, GFRP	8	10	12				◎			F56

◎: Excellent ○: Good

F KORLOY Endmills

Type	Shape	Designation	Grade	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	Hardened steel	
I + Endmill	Flat	IPFE2000	PC320		○	General	2	1	20	◎	○	◎	○	○		F60
		IPFE4000	PC320		○	General	4	1	20	◎	○	◎	○	○		F62
	Long flat	IPLFE2000	PC320		○	General	2	1	20	◎	○	◎	○	○		F61
		IPLFE4000	PC320		○	General	4	1	20	◎	○	◎	○	○		F63
	Ball	IPBE2000	PC320		○	General	2	1	20	◎	○	◎	○	○		F64
	Ball	IPBE4000	PC320		○	General	4	1	20	◎	○	◎	○	○		F66
	Long ball	IPLBE2000	PC320		○	General	2	1	16	◎	○	◎	○	○		F65
	Radius	IPRE2000	PC320		○	General	2	1	12	◎	○	◎	○	○		F67 F68
		IPRE4000	PC320		○	General	4	2	12	◎	○	◎	○	○		F70
	Long radius	IPLRE2000	PC320		○	General	2	3	12	◎	○	◎	○	○		F69
		IPLRE4000	PC320		○	General	4	3	12	◎	○	◎	○	○		F71
Z + Endmill new	Flat	ZPFE2000	PC320U		○	General	2	1	20	◎	○	◎	○	○		F75
	Short flat	ZPSFE2000	PC320U		○	General	2	1	16	◎	○	◎	○	○		F76
	Long flat	ZPLFE2000	PC320U		○	General	2	2	20	◎	○	◎	○	○		F76
	Long flute	ZPLFE2000	PC320U		○	General	2	2	20	◎	○	◎	○	○		F77
	Flat	ZPFE4000	PC320U		○	General	4	1	20	◎	○	◎	○	○		F78
	Short flat	ZPSFE4000	PC320U		○	General	4	1	16	◎	○	◎	○	○		F79
	Long flat	ZPLFE4000	PC320U		○	General	4	2	20	◎	○	◎	○	○		F80

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Type	Shape	Designation	Grade	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	
Z+ Endmill new	Long flute	ZPLFE4000	PC320U		○	General	4	1	20	◎	○	◎		○		F81
	Flat	ZPFE3000	PC320U		○	General	3	2	25	◎	○	◎		○		F82
		ZPFE6000	PC320U		○	General	6	6	20	◎	○	◎		○		F82
	Ball	ZPBE2000	PC320U		○	General	2	0.8	20	◎	○	◎		○		F83
	Long ball	ZPLBE2000	PC320U		○	General	2	2	12	◎	○	◎		○		F84
	Ball	ZPBE4000	PC320U		○	General	4	2	20	◎	○	◎		○		F84
	Radius	ZPRE2000	PC320U		○	General	2	1	16	◎	○	◎		○		F85
	Long radius	ZPLRE2000	PC320U		○	General	2	6	16	◎	○	◎		○		F86
	Radius	ZPRE4000	PC320U		○	General	4	1.5	16	◎	○	◎		○		F87
	Long radius	ZPLRE4000	PC320U		○	General	4	6	16	◎	○	◎		○		F88
S+ Endmill new	Flat	SPFE4000	PC320S		—	STS	4	1	12	○	◎	○		◎		F91
	Long flat	SPLFE4000	PC320S		—	STS	4	1	12	○	◎	○		◎		F91
R+ Endmill	Roughing	RPAE	FN30T		—	Aluminum	3	6	25					◎		F97
		RPE-FP-H	PC30T		○	General	4	5	20	◎	○	◎		○		F97
		RPLE-FP-H	PC30T		○	General	4	5	20	◎	○	◎		○		F98
		RPE-XG	PC30T		○	General	4	6	20	◎	○	◎		○		F98
		RPE-FP-L	PC30T		○	General	4	5	20	◎	○	◎		○		F99
		RPE-RG	PC40T		○	General	4	5	20	◎	○	◎		○		F99

◎: Excellent ○: Good

F KORLOY Endmills

Type	Shape	Designation	Grade	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 resistance, titanium alloy	Hardened steel	
R+ Endmill	Roughing	RPE-RG	HN30T HC30T		○	General	4	6	20	◎	○	◎	○	○		F100
		RPE-FF	HC30T		○	General	4	6	20	◎	○	◎	○	○		F100
		RPE-FP	HC30T		○	General	4	6	20	◎	○	◎	○	○		F101
		RPE-RG	HN20T HC10T HC20T		○	General	4	6	50	◎	○	◎	○	○		F102
A+ Endmill	Flat	APFE2000	H05S		—	Aluminum	2	1	20				◎			F105
		APFE3000	H05S		—	Aluminum	3	1	20				◎			F105
	Middle flat	APMFE2000	H05S		—	Aluminum	2	3	20				◎			F106
		APMFE3000	H05S		—	Aluminum	3	3	20				◎			F106
PCD Endmill	Flat	PDE1000	DP200		—	Nonferrous, High speed	1	4.6	6				◎			F115
		PDE2000	DP200		—	Nonferrous, High speed	2	6	12				◎			F115
Brazed Endmill	Flat	ZSE200	FCC PC221F		— (○)	Cast iron, Steel	2	14	50	○	○	◎		○		F118
		ZSE300	FCC PC221F		— (○)	Cast iron, Steel	3	14	50	○	○	◎		○		F118 F119
		ZSE400	FCC PC221F		— (○)	Cast iron, Steel	4	14	50	○	○	◎		○		F119
		ZSE600	FCC PC221F		— (○)	Cast iron, Steel	6	34	50	○	○	◎		○		F119
		ZSEA200	FCC		—	Aluminum, Copper	2	15	50				◎			F120
	Long flat	ZSEL200	FCC PC221F		—	Cast iron, Steel	2	14	50	○	○	◎		○		F121
		ZSEL400	FCC PC221F		—	Cast iron, Steel	4	16	40	○	○	◎		○		F121
		ZSEXL200	FCC PC221F		—	Cast iron, Steel	2	20	25	○	○	◎		○		F121
	Ball	ZSBE200	FCC PC221F		—	Cast iron, Steel	2	13	50	○	○	◎		○		F122

◎: Excellent ○: Good



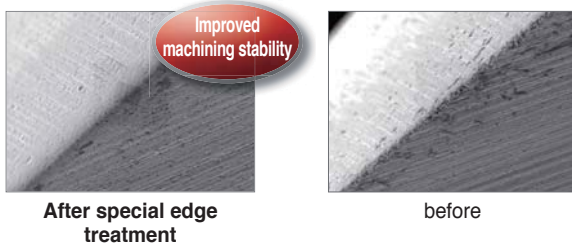
Endmill for high speed machining for high hardened steel

H Endmill **new**

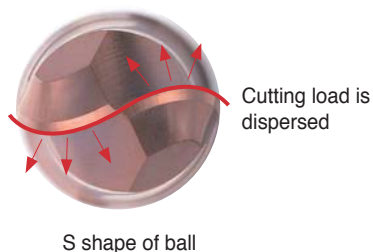
- For cutting high hardened and heat-treated steel under HRC70
- New coating technology improves wear resistance
- A new shape improves machinability
- High speed and highly accurate machining available

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

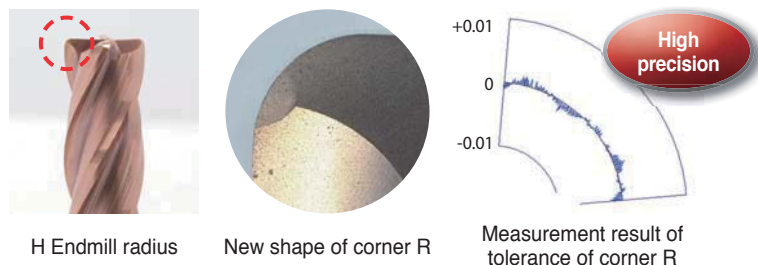


PBE (Ball)



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

PRE (Radius)

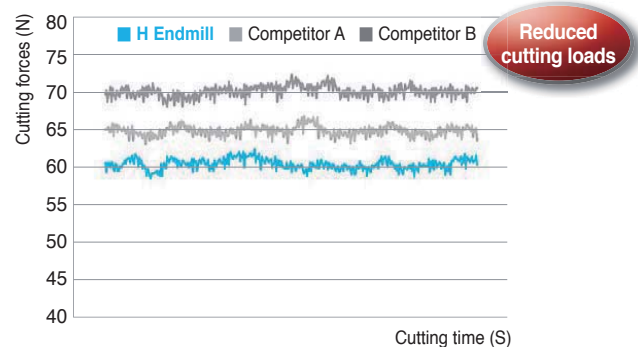


- The new shape of corner R reduces cutting loads
- The tolerance of corner R is under ± 0.005 mm

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

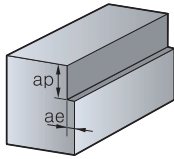


F Technical Information for H Endmill

Recommended cutting conditions (PRE4000 Radius)

Workpiece Conditions Diameter (Ø)	Above HRC40 (HPM1, KP4M, etc.)		Below HRC55 (NAK55, NAK80, STAVAX, etc.)		HRC55~HRC70 (STD11, STD61, etc.)	
	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



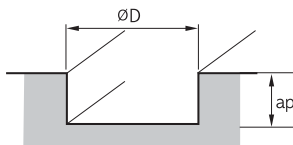
- Shouldering depth (ap) and radial depth (ae)
 - $ap = 0.1D$
 - $ae = 0.03D$

* 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)	Above HRC40 (HPM1, KP4M, etc.)		Below HRC55 (NAK55, NAK80, STAVAX, etc.)		HRC55~HRC70 (STD11, STD61, etc.)	
	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)
 - $ap = 0.05D$
 - $ae = 1.0D$

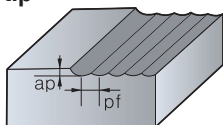
* Workpiece should be clamped rigidly. In case of vibration, reduce R.P.M and feed rate by the same ratio



Recommended cutting conditions (PBE2000 Ball)

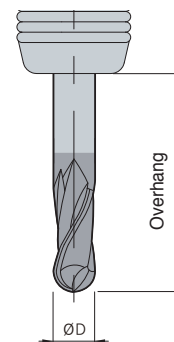
Workpiece Conditions Diameter(Ø)	Above HRC40 (HPM1, KP4M, etc.)		Under HRC55 (NAK55, NAK80, STAVAX, etc.)		HRC55~HRC70 (STD11, STD61, etc.)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
0.5	35,000	1,470	31,500	1,330	28,000	1,050
1	35,000	2,940	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

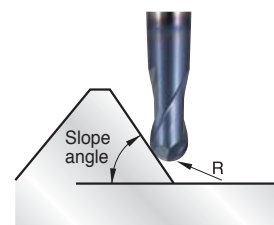
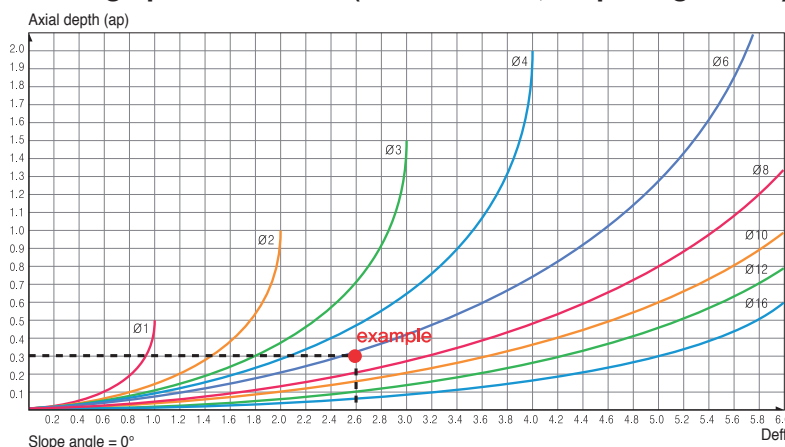
- For shank taper type, Cutting conditions are based on the case of being clamped at neck part
 - When the overhang is increased by 1D in comparison to the overhang, decrease R.P.M and feed by 10%
- In case of the straight type adjust conditions according to the overhang
 - Ex: When the overhang is 3D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

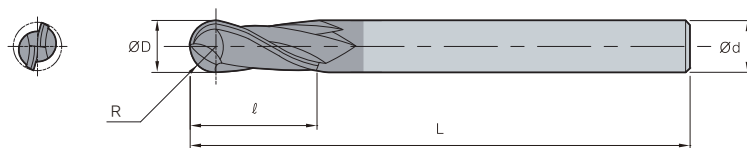


Ex) Diameter: 6 mm, $ap = 0.3$ mm,
 $Deff = 2.6$ mm, $N = 14,000$ (min^{-1})
 Slope angle 0° : $V_{eff} = 113.7$ (m/min)
 Slope angle 15° : $V_{eff} = 113.7 \times 1.5 = 170.6$ (m/min)

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)



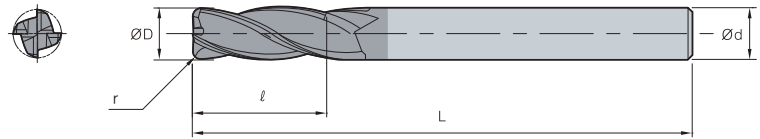
ØD	Tolerance
~Ø5.9	0.00~-0.015
Ø6.0~	0.00~-0.025



(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

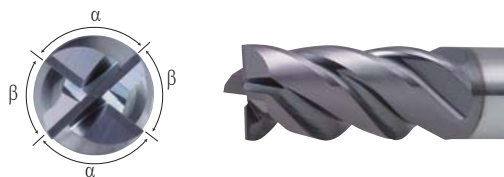
Improved productivity with effective machining due to less vibration

V Endmill

Variable Endmill

- Irregular helix angle
- Irregular indexing angle

* Irregular flute spacing = Decreased vibration by setting up cutting edges position variably

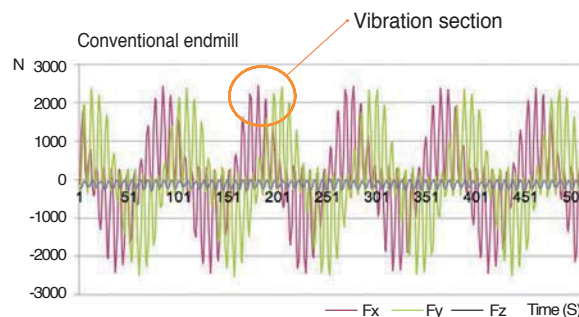
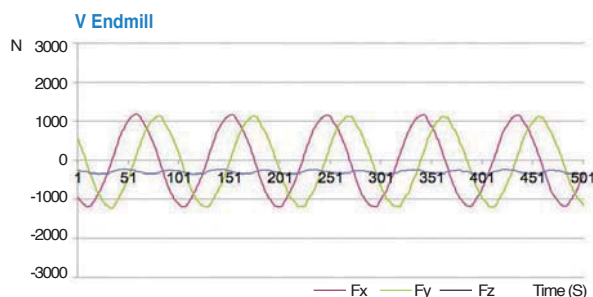


Features

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

Performance (Vibration test)

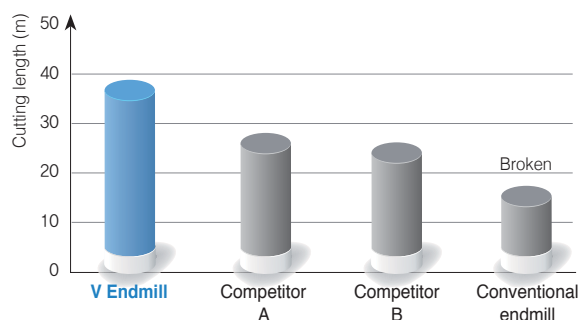
- **Workpiece** SCM440
- **Cutting condition** D = Ø8.0, n (m/min) = 3183, vc (m/min) = 80, vf (mm/min) = 713, fz (mm/t) = 0.055, ap (mm) = 8.0, ae (mm) = 8, dry
- **Tools** V Endmill VFE4080-060, Conventional endmill



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

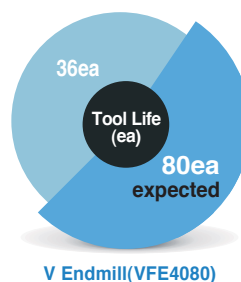
- **Workpiece** SNCM439 (HRC 43~45)
- **Cutting condition** D = Ø8.0, n (m/min) = 6000, vc (m/min) = 150, vf (mm/min) = 600, fz (mm/t) = 0.025, ap (mm) = 7, ae (mm) = 0.8, wet (Water-soluble)
- **Tools** VFE4080-060



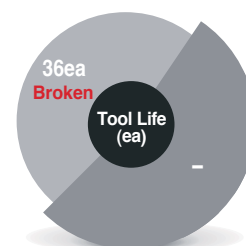
V Endmill



Conventional endmill



V Endmill(VFE4080)



Conventional endmill

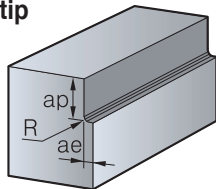


Recommended cutting conditions

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



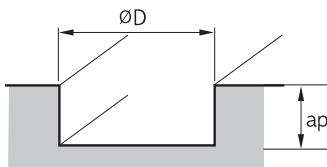
※ Cutting condition by overhang

1. Standard overhang: Follow cutting condition above
2. Long overhang: When the overhang is increased by 10 mm, 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

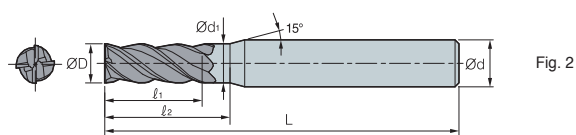
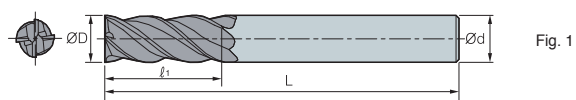
Application tip



※ Cutting condition by overhang

1. Standard overhang: Follow cutting condition above
2. Long overhang: When the overhang is increased by 10 mm, 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



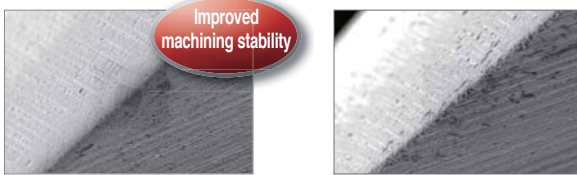
Fine performance and high quality Endmill for general cutting

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 edge design for less chipping and stable machining

Features

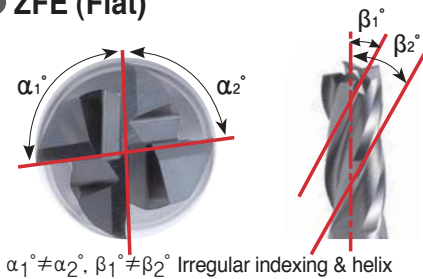
- New grade (PC315E) - Fine substrate and lubricative coating guarantee excellent performance at high speed and high temperature
- Special edge treatment - Special cutting-edge design was applied for less chipping and longer tool life
- High accuracy with tolerance-h5 - High quality production system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



After special edge treatment

before

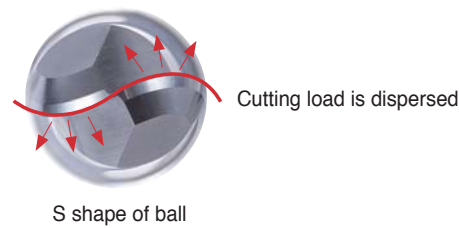
ZFE (Flat)



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

- Irregular indexing & helix prevent chattering and improve surface

ZBE (Ball)



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

Application examples

- **Workpiece** Carbon steel (SM45C, ~ 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

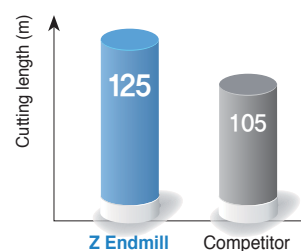


Z Endmill



Competitor

Test result



- Cutting edge treatment for less chipping

- **Workpiece** Carbon steel (SM45C, ~ 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

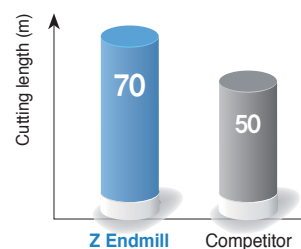


Z Endmill



Competitor

Test result



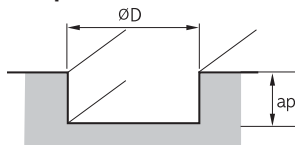
- New grade improves wear resistance

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



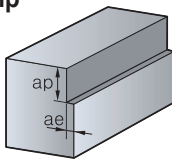
- Slotting depth (ap)
 - D ≤ Ø3 (ap = 0.2D)
 - D > Ø3 (ap = 0.5D)

* 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

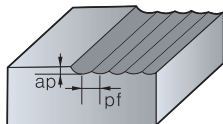
* Workpiece should be clamped rigidly. In case of vibration, reduce R.P.M and feed rate by the same ratio



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



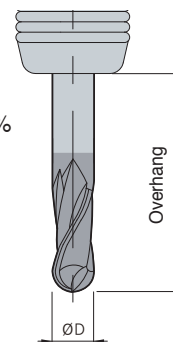
• $ap = 0.03D$

• $pf = 0.05D$

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

Cutting condition by overhang

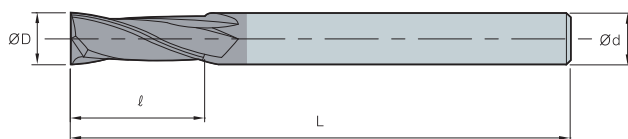
- For shank taper type, Cutting conditions are based on the case of being clamped at neck part
 - When the overhang is increased by 1D in comparison to the overhang, decrease R.P.M and feed by 10%
- In case of the straight type adjust conditions according to the overhang
 - Ex: When the overhang is 3D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



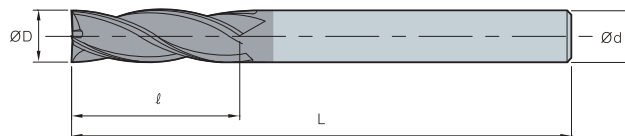
ØD	Tolerance
~Ø5.9	0.00~-0.015
Ø6.0~	0.00~-0.025



(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)

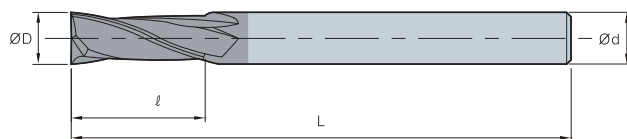
ØD	Tolerance
~Ø5.9	0.00~ -0.015
Ø6.0~	0.00~ -0.025



(mm)

Designation	ØD	Ød	ℓ	L
ZFE				
4 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)



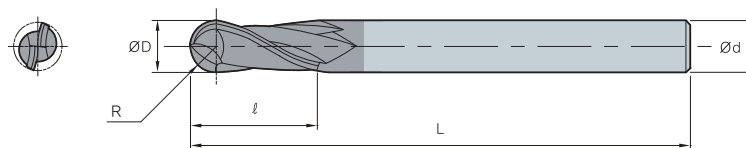
ØD	Tolerance
~Ø5.9	0.00~ -0.015
Ø6.0~	0.00~ -0.025



(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
	2100-065	10	10	15	65
	2120-070	12	12	18	70
ZSFE 4	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					
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

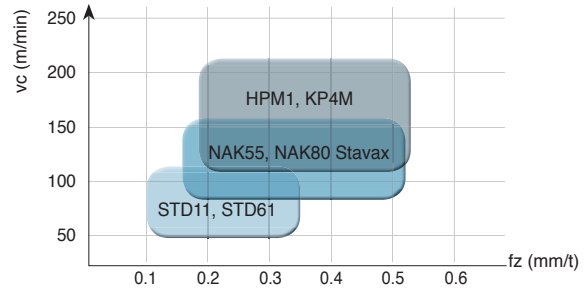
- Improved productivity and shortened working time thanks to high feed capability
- Manufacturing cost reduction could be expected as it enables to apply highly efficient machining

Feature



- Highly efficient operation by setting up wider chip pocket area
- High feed machining is possible by dispersing cutting forces

Application by workpiece

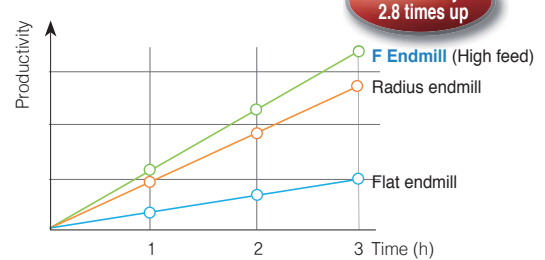


Productivity example

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	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

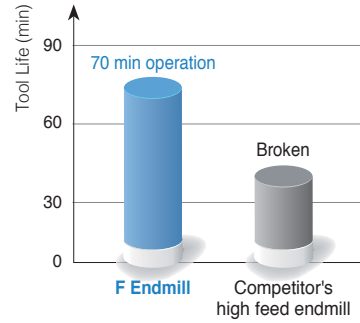


Application examples

- Workpiece STD61+SKT (HRC45~50)
- Cutting condition $D = \varnothing 12$, n (min⁻¹) = 4000, vc (m/min) = 150.8, vf (mm/min) = 4000, fz (mm/t) = 0.25, ap (mm) = 3.6, ae (mm) = 0.6, dry
- Tools FME4120-075-R12



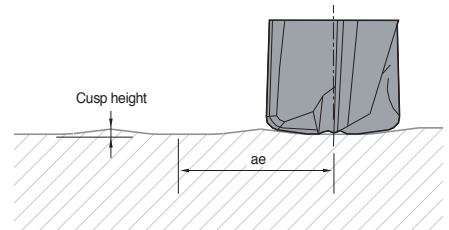
Test result



Recommended cutting conditions

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 steel Hrc55~ (SKD11, STD61)			
	RPM n (min ⁻¹)	Feed vf (mm/min)	ap (mm)	ae (mm)	RPM n (min ⁻¹)	Feed vf (mm/min)	ap (mm)	ae (mm)	RPM n (min ⁻¹)	Feed vf (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

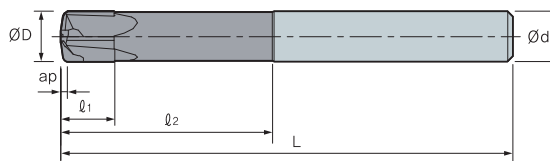
Roughing cut

Diameter (ØD)	Mold steel Hrc35~45 (HPM1, KP4M)				Mold steel Hrc45~55 (NAK55, NAK80, STAVAX)				Heat treated steel Hrc55~ (SKD11, STD61)			
	RPM n (min ⁻¹)	Feed vf (mm/min)	ap (mm)	ae (mm)	RPM n (min ⁻¹)	Feed vf (mm/min)	ap (mm)	ae (mm)	RPM n (min ⁻¹)	Feed vf (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 10 mm from the standard items, decrease feed 5% & ae 5%

FME4000 (High feed)



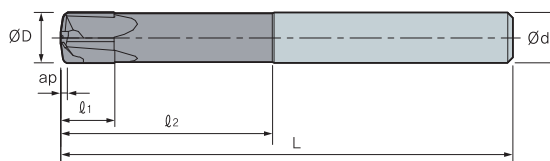
ØD	Tolerance
Ø6~Ø12	-0.01~-0.03



(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 (High feed long)



ØD	Tolerance
Ø6~Ø12	-0.01~-0.03



(mm)

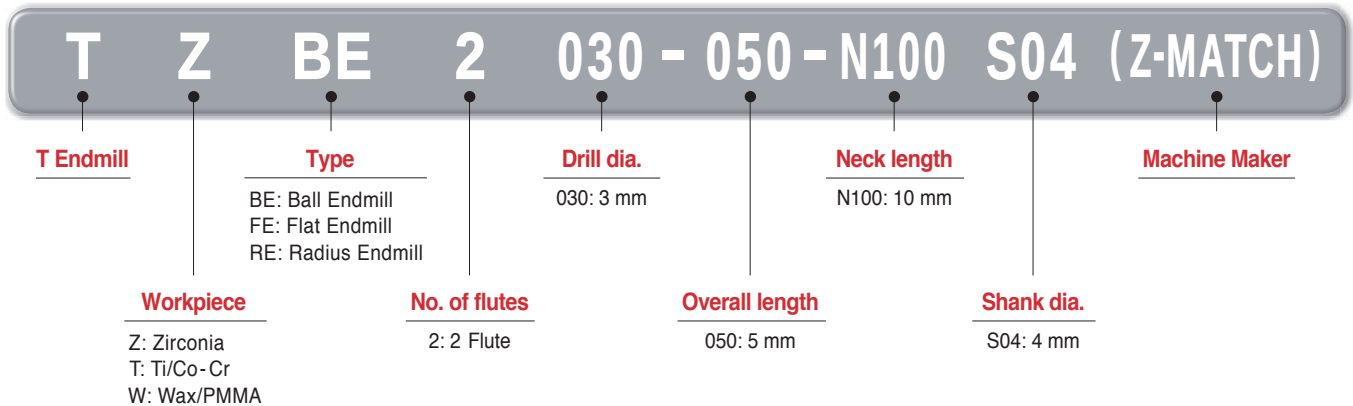
Designation		R	ØD	Ød	ℓ ₁	ℓ ₂	L	Max. ap (mm)	CAM-Radius
 FMLE	4060-090-R05	0.5	6	6	4.5	30	90	0.35	0.7
	4080-090-R05	0.5	8	8	6	40	90	0.45	0.8
	4100-100-R10	1.0	10	10	7.5	50	100	0.65	1.3
	4120-110-R12	1.2	12	12	9	60	110	0.78	1.6

Endmill for machining dental prostheses

T Endmill new

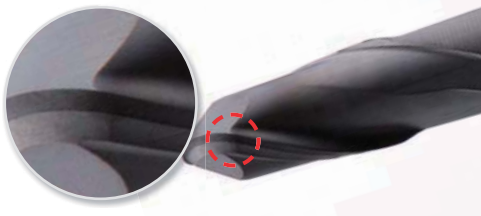
- For machining dental prostheses made of zirconia, titanium, Co-Cr, wax, PMMA, etc
- Optimized cutting performance by matching a proper grade with each type of materials
- Inhibited unevenness and excellent finish in machined surfaces due to the optimized cutting-edge design
- Specialized tool shape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

Code system



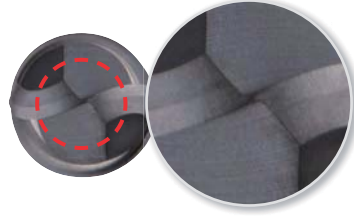
Features

- 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

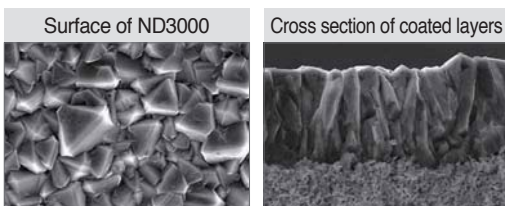


Center-Matched ball shape

- Optimized center 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

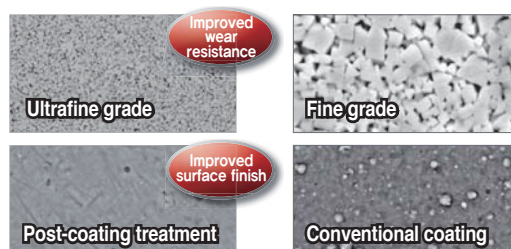


High hardness diamond coating (Hv 10,000) provides excellent wear resistance

Specialized grade for Zirconia provides excellent adhesion

Grade solution for titanium

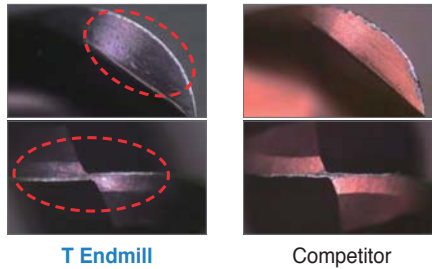
- **Development of PC2510 (Coated grade for high hardened steel)**
 - Post-coating treatment was applied to improve surface finish
 - A grade optimized for interrupted machining of high hardness steels and wet treatment accompanying high thermal shock. Its ultrafine substrate features high toughness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



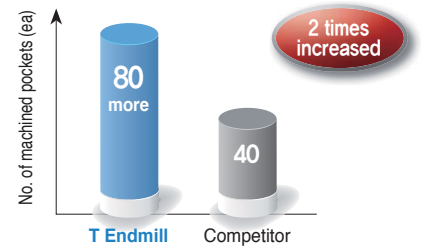
F Technical Information for T Endmill

Performance evaluation

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



Test result



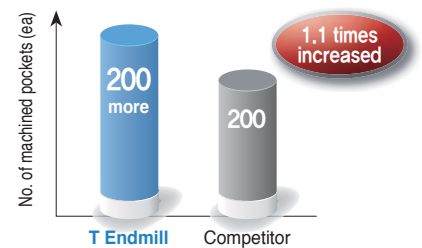
Excellent resistance to toughness and wear thanks to the new grade PC2510

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

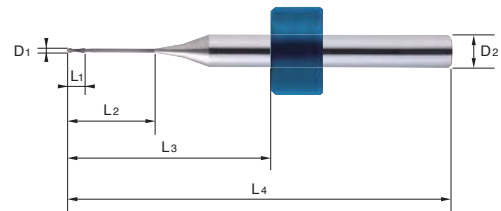


Special T Endmill order form

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

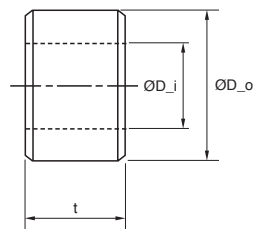
[Data sheet]

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	

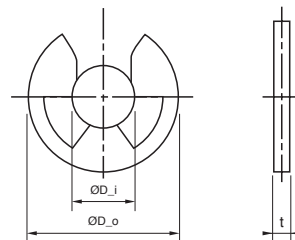


* Should you make a special order, please complete this form and send it to an adjacent KORLOY sales office

[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 D Endmill

Diamond coated endmill

D Endmill new

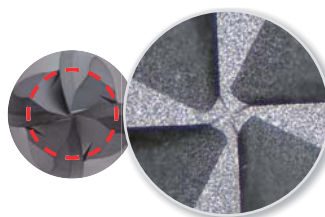
- Tangential cutting-edge geometries for excellent surface finish
- Excellent wear resistance due to high hardness and high purity diamond coating
- Advanced surface finish and cutting performance thanks to sharp edges and tangential tool geometries

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)

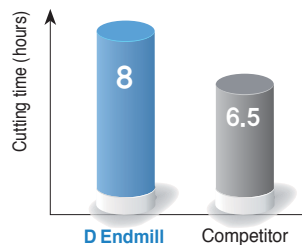
- Ball point shape for high feed machining
- Improved rigidity and excellent surface finish

Application examples

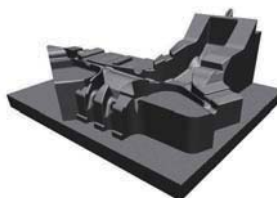
- **Workpiece** Graphite mold
- **Cutting conditions**
 - vc (m/min) = 100,
 - fz (mm/t) = 0.11
 - ap (mm) = 0.26, dry
- **Tools** DBE4060-110-N250S06



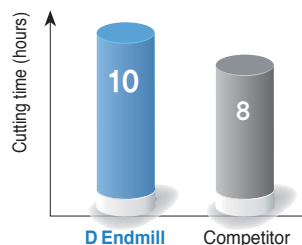
Test result



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



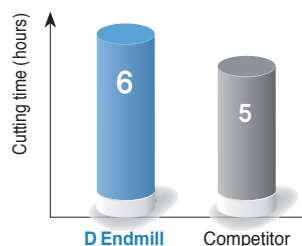
Test result



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



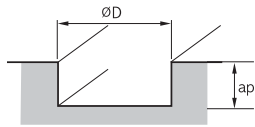
Test result



Recommended cutting conditions (Flat)

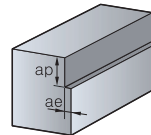
Tool	DFE2000 (Slotting)		DFE2000 (Shouldering)		DFE4000 (Shouldering)	
Workpiece	Graphite					
Conditions	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
Diameter (Ø)						
1	40,000	500	40,000	700	-	-
2	25,000	570	25,000	800	25,000	1,600
3	20,000	570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

Application tip



Slotting depth (ap)

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



Shouldering depth (ap)

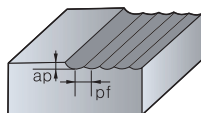
- $D \leq \varnothing 2.5$, $ap = 1.5D$, $ae = 0.05D$
- $D > \varnothing 2.5$, $ap = 1.5D$, $ae = 0.1D$

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

Recommended cutting conditions (Ball)

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)

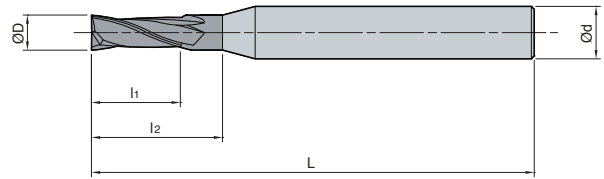
- $ap = 0.2D$
- $pf = 0.2D$

* 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)

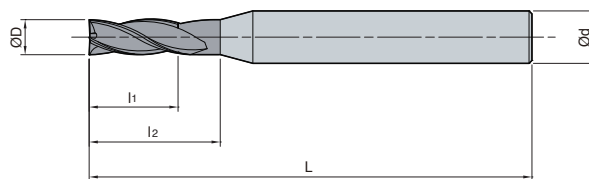


ØD	Tolerance
~Ø5.9	0.00~ -0.02
Ø6.0~	0.00~ -0.03

(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

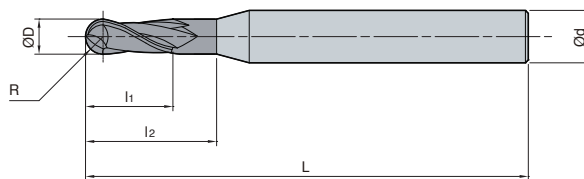


DFE4000 (Flat)

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

Designation		ØD	Ød	l ₁	l ₂	L	(mm)
DFE 	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)

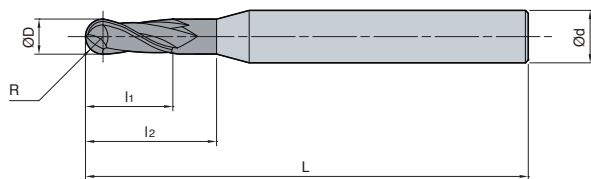


ØD	Tolerance
~Ø5.9	0.00~-0.02
Ø6.0~	0.00~-0.03

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

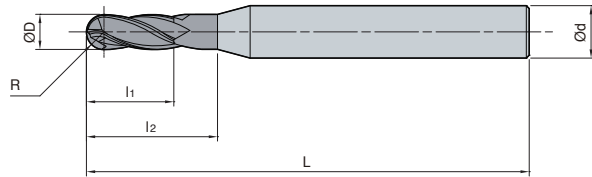


DBE2000 (Ball)

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						
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



Good chip evacuation and fine resistance for built up edge

Solid Endmills for Aluminum

- Good surface finish with minimized cutting load and built-up edge occurrence
- DLC coating
 - Higher hardness (Hv3000-7000), About 3 to 6 times longer tool life comparing uncoated endmill
 - Fine surface roughness on workpiece with excellent lubricative effect by low friction co-efficient ($\mu < 0.1$)
- Superior in Aluminum, Aluminum alloys, Copper and Copper alloys

Features of copper & aluminum machining

- Built-up edge is easily generated though the workpiece has low cutting resistance and chip-removal is fine
- As it has high coefficient of thermal expansion, deflection degree due to machining heat is huge, and it also influences to workpiece quality and residual stress
- While machining, chips can easily damage on the workpiece's surface as the workpiece has low hardness, and tool life is over due to flank wear in general

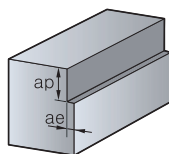
Trouble shooting for copper & aluminum machining

- Use a higher rake angled tool with sharper edges, and minimizes cutting load and built-up edge generating by using oil (MQL) mist
- Increase Vc and reduce the depth of cut for a better surface finish and productivity

Recommended cutting conditions (SSEA2000)

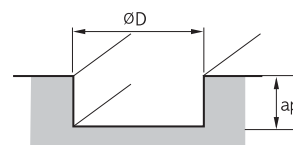
Workpiece Condition Diameter (Ø)	Shouldering				Slotting			
	Aluminum alloy (A7075)		Aluminum alloy (cast) (AC4B)		Aluminum alloy (A7075)		Aluminum alloy (cast) (AC4B)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
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)

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

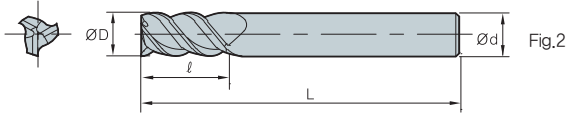
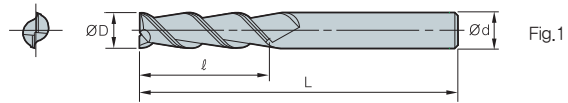


Slotting depth (ap)

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

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

SSEA2000/3000 (Flat)



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

(mm)

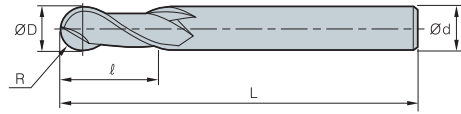
	Designation	ØD	Ød	ℓ	L	Fig.
SSEA 2	2010	1	6	3	40	1
	2015	1.5	6	4	40	1
	2020	2	6	6	40	1
	2025	2.5	6	7	40	1
	2030	3	6	10	45	1
	2035	3.5	6	10	45	1
	2040	4	6	12	45	1
	2050	5	6	15	50	1
	2060	6	6	15	50	1
	2070	7	8	20	60	1
	2080	8	8	20	60	1
	2090	9	10	20	70	1
	2100	10	10	25	70	1
	2110	11	12	25	75	1
	2120	12	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 3	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.L: 17, L: 60 SSBEA3063 17-60L

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

F Technical Information for C-Max

(Copper)

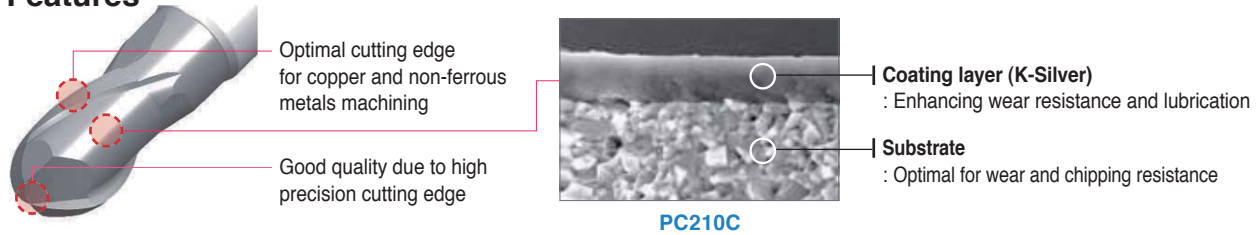
Long tool life and good surface roughness for copper based electrode machining

C-Max

Copper

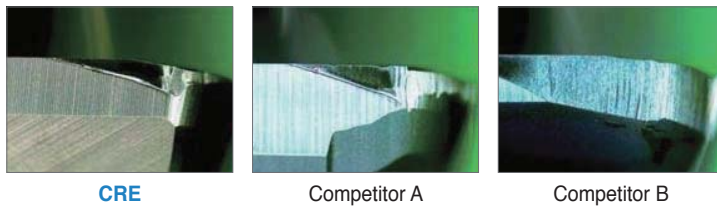
- Superior lubricity, wear resistance & chipping resistance due to the K-Silver coating layer and optimal substrate
- Optimal for copper and non-ferrous metal machining
- Wide line up (ball, flat, radius & long neck type)

Features

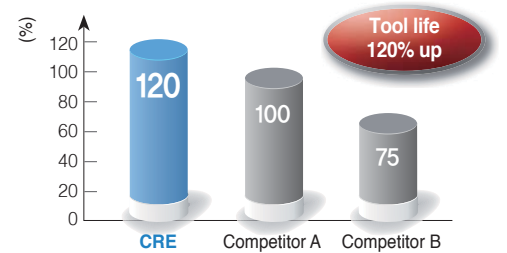


Application example

- 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



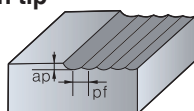
Test result



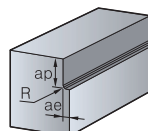
Recommended cutting conditions

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

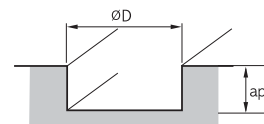
Application tip



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



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

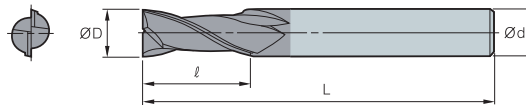


- $ap \leq 1.5D$

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



CFE2000 (Flat)

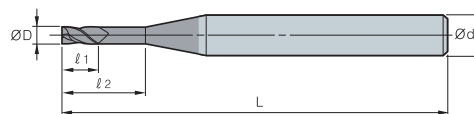


ØD	Tolerance
Ø0.5~Ø6	0.00~0.01
Ø8~Ø12	0.00~0.02

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

(mm)

CFNE2000 (Long neck flat)

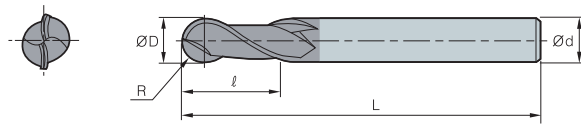


ØD	Tolerance
Ø0.5~Ø6	0.00~0.01
Ø8~Ø12	0.00~0.02

Designation		ØD	Ød	ℓ ₁	ℓ ₂	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

(mm)

CBE2000 (Ball)

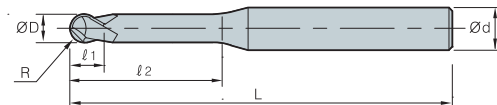


ØD	Tolerance	R Tolerance
Ø0.5~Ø6	0.00~0.01	±0.005
Ø8~Ø12	0.00~0.02	±0.005

(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)



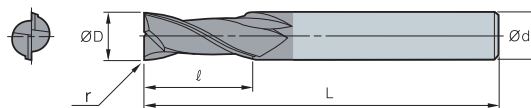
ØD	Tolerance
Ø0.5~Ø6	0.00~0.01
Ø8~Ø12	0.00~0.02

(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



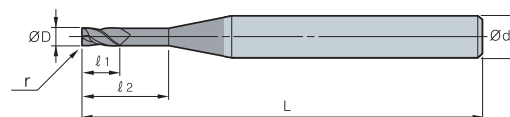
CRE2000 (Radius)



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 Super Endmill for HRSA

Endmill for Ni series HRSA machining (Inconel, Hastelloy, Waspaloy and etc.)

Super Endmill for HRSA new

- Exclusive endmill for plane engines, generator and turbine parts.
- Optimal endmill for Ni Based super alloy HRSA machining (Inconel, Hastelloy, Waspaloy and etc.)

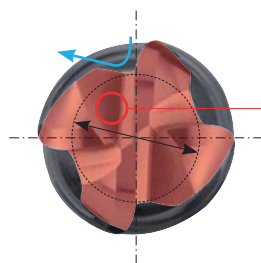
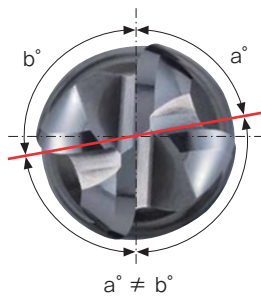
* HRSA: Heat Resistance Super Alloy. Heating resisting alloy

Code system

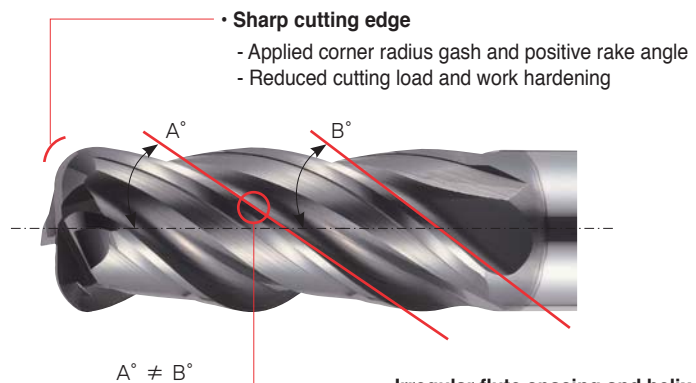
S	RE	S	4	120	- 080	- R30
Super Endmill	Type	Workpiece	No. of flutes	Tool diameter	Overall length	Corner R
	R: Radius Endmill	S: Super alloy T: Titanium/STS	4: 4 Flute	120: Ø12.0 mm	080: 80 mm	30: 30 mm

Features

- Aerospace and generator industries: Exclusive endmill for HRSA and machining parts of engine and turbine
- Irregular flute spacing and helix angle design: Reducing chattering and improving stability in machining
- High rigidity core web design: Improving chip evacuation and stability in machining
- Sharp cutting edge: Reducing cutting load and work hardening
- Excellent tool life: New grade with excellent wear resistance coating and high toughness substrate

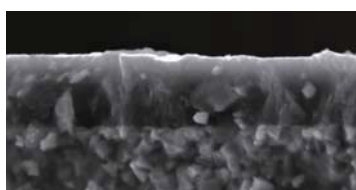


- **High rigidity core web design**
 - Improved chip evacuation
 - Increased machining stability



- **Sharp cutting edge**
 - Applied corner radius gash and positive rake angle
 - Reduced cutting load and work hardening
- **Irregular flute spacing and helix angle**
 - Reducing chattering
 - Increasing machining stability

Features of grade



Super Lubricating Coating

- **High lubricative coating and special surface treatment technology**
 - Surface treatment technology improves welding resistance and machining stability



Performance evaluation

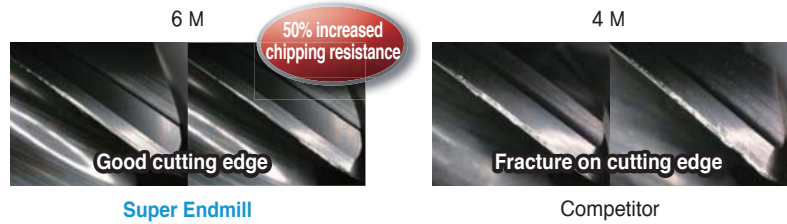
- **Workpiece** Inconel718 (HRC43~46)
- **Cutting conditions** Diameter = $\varnothing 12$, vc (m/min) = 40, fz (mm/t) = 0.05, ap (mm) = 18, ae (mm) = 0.6, wet (Emulsion)
- **Tools** SRES4120-080-R10(SL Coating)

High quality due to high toughness substrate and improved machining stability



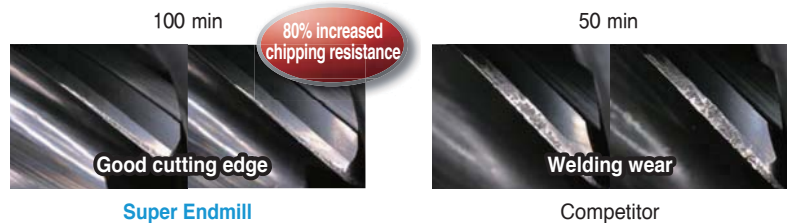
- **Workpiece** Inconel718 (HRC43~46)
- **Cutting conditions** Diameter = $\varnothing 12$, vc (m/min) = 40, fz (mm/t) = 0.05, ap (mm) = 18, ae (mm) = 0.6, wet (Soluble)
- **Tools** SRES4120-080-R10(SL Coating)

High quality due to high toughness substrate and improved machining stability



- **Workpiece** Waspaloy (HRC36~38)
- **Cutting conditions** Diameter = $\varnothing 12$, vc (m/min) = 30, fz (mm/t) = 0.04, ap (mm) = 6, ae (mm) = 18, Trochoidal machining wet (Soluble)
- **Tools** SRES4120-080-R10(SL Coating)

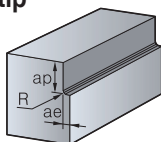
High quality due to high toughness substrate and improved machining stability



Recommended cutting conditions

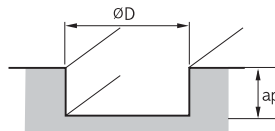
Workpiece Condition Diameter ($\varnothing$)	Ni based heat resistant super alloy (Inconel718, 625)			
	RPM n (min ⁻¹)	Feed vf (mm/min)	RPM n (min ⁻¹)	Feed vf (mm/min)
3	3,800	220	2,500	125
4	3,000	240	1,900	135
5	2,450	245	1,500	145
6	2,100	250	1,250	145
8	1,600	225	945	155
10	1,250	215	760	145
12	1,050	210	630	145
16	765	210	475	110
20	635	200	380	110

Application tip



Shouldering depth (ap)

- $ap : \leq 1.5D$
- $ae : \leq 0.05D$



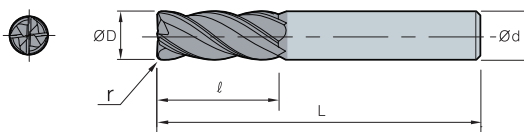
Slotting depth (ap)

- $ap : \leq 0.2D$

Notice

- Please adjust the recommended cutting conditions properly, according to the condition of your machines, the target shapes, and your purpose for machining
- Please set the machine with high rigidity and check the workpiece clamping
- Please select proper coolant for workpiece materials and check the pressure and amount of coolant enough for machining
- In case of chattering, reduce RPM and feed rate by the same ratio

SRES4000 (Radius)



ØD	Tolerance	R Tolerance
Ø1~Ø6	0.00 ~ -0.015	±0.01
Ø6.1~Ø20	0.00 ~ -0.020	±0.01

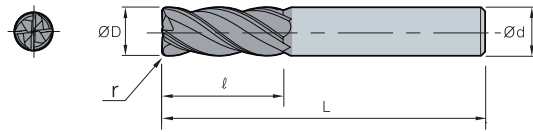


(mm)

	Designation	ØD	Ød	ℓ	L	r
SRES 4	4030-055-R02	3	6	8	55	0.2
	4030-055-R03	3	6	8	55	0.3
	4030-055-R05	3	6	8	55	0.5
	4040-055-R02	4	6	10	55	0.2
	4040-055-R03	4	6	10	55	0.3
	4040-055-R05	4	6	10	55	0.5
	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
	4050-055-R02	5	6	15	55	0.2
	4050-055-R03	5	6	15	55	0.3
	4050-055-R05	5	6	15	55	0.5
	4050-090-R02	5	6	15	90	0.2
	4050-090-R03	5	6	15	90	0.3
	4050-090-R05	5	6	15	90	0.5
	4060-060-R03	6	6	15	60	0.3
	4060-060-R05	6	6	15	60	0.5
	4060-060-R08	6	6	15	60	0.8
	4060-060-R10	6	6	15	60	1
	4060-060-R15	6	6	15	60	1.5
	4060-060-R20	6	6	15	60	2
	4060-090-R03	6	6	15	90	0.3
	4060-090-R05	6	6	15	90	0.5
	4060-090-R08	6	6	15	90	0.8
	4060-090-R10	6	6	15	90	1
	4060-090-R15	6	6	15	90	1.5
	4060-090-R20	6	6	15	90	2



SRES4000 (Radius)



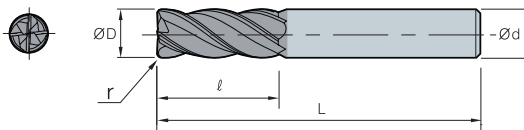
ØD	Tolerance	R Tolerance
Ø1~Ø6	0.00 ~ -0.015	±0.01
Ø6.1~Ø20	0.00 ~ -0.020	±0.01



(mm)

Designation	ØD	Ød	l	L	r
SRES					
4080-070-R03	8	8	20	70	0.3
4080-070-R05	8	8	20	70	0.5
4080-070-R08	8	8	20	70	0.8
4080-070-R10	8	8	20	70	1
4080-070-R15	8	8	20	70	1.5
4080-070-R20	8	8	20	70	2
4080-070-R25	8	8	20	70	2.5
4080-070-R30	8	8	20	70	3
4080-100-R03	8	8	20	100	0.3
4080-100-R05	8	8	20	100	0.5
4080-100-R08	8	8	20	100	0.8
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
4100-075-R03	10	10	25	75	0.3
4100-075-R05	10	10	25	75	0.5
4100-075-R08	10	10	25	75	0.8
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
4100-100-R03	10	10	25	100	0.3
4100-100-R05	10	10	25	100	0.5
4100-100-R08	10	10	25	100	0.8
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

SRES4000 (Radius)



ØD	Tolerance	R Tolerance
Ø1~Ø6	0.00 ~ -0.015	±0.01
Ø6.1~Ø20	0.00 ~ -0.020	±0.01

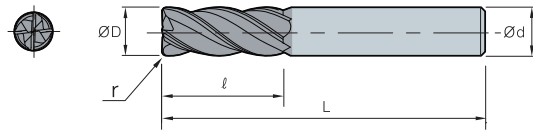


(mm)

	Designation	ØD	Ød	l	L	r
SRES 4	4120-080-R05	12	12	30	80	0.5
	4120-080-R08	12	12	30	80	0.8
	4120-080-R10	12	12	30	80	1
	4120-080-R15	12	12	30	80	1.5
	4120-080-R20	12	12	30	80	2
	4120-080-R25	12	12	30	80	2.5
	4120-080-R30	12	12	30	80	3
	4120-080-R35	12	12	30	80	3.5
	4120-080-R40	12	12	30	80	4
	4120-110-R05	12	12	30	110	0.5
	4120-110-R08	12	12	30	110	0.8
	4120-110-R10	12	12	30	110	1
	4120-110-R15	12	12	30	110	1.5
	4120-110-R20	12	12	30	110	2
	4120-110-R25	12	12	30	110	2.5
	4120-110-R30	12	12	30	110	3
	4120-110-R35	12	12	30	110	3.5
	4120-110-R40	12	12	30	110	4
	4140-090-R05	14	14	35	90	0.5
	4140-090-R08	14	14	35	90	0.8
	4140-090-R10	14	14	35	90	1
	4140-090-R15	14	14	35	90	1.5
	4140-090-R20	14	14	35	90	2
	4140-090-R30	14	14	35	90	3
	4140-150-R05	14	14	35	150	0.5
	4140-150-R08	14	14	35	150	0.8
	4140-150-R10	14	14	35	150	1
	4140-150-R15	14	14	35	150	1.5
	4140-150-R20	14	14	35	150	2
	4140-150-R30	14	14	35	150	3



SRES4000 (Radius)



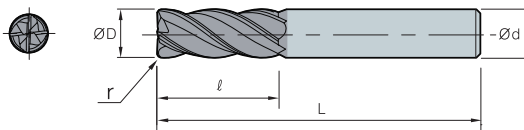
ØD	Tolerance	R Tolerance
Ø1~Ø6	0.00 ~ -0.015	±0.01
Ø6.1~Ø20	0.00 ~ -0.020	±0.01



(mm)

	Designation	ØD	Ød	l	L	r
SRES 	4160-100-R05	16	16	42	100	0.5
	4160-100-R08	16	16	42	100	0.8
	4160-100-R10	16	16	42	100	1
	4160-100-R15	16	16	42	100	1.5
	4160-100-R20	16	16	42	100	2
	4160-100-R25	16	16	42	100	2.5
	4160-100-R30	16	16	42	100	3
	4160-100-R35	16	16	42	100	3.5
	4160-100-R40	16	16	42	100	4
	4160-100-R50	16	16	42	100	5
	4160-100-R60	16	16	42	100	6
	4160-150-R05	16	16	42	150	0.5
	4160-150-R08	16	16	42	150	0.8
	4160-150-R10	16	16	42	150	1
	4160-150-R15	16	16	42	150	1.5
	4160-150-R20	16	16	42	150	2
	4160-150-R25	16	16	42	150	2.5
	4160-150-R30	16	16	42	150	3
	4160-150-R35	16	16	42	150	3.5
	4160-150-R40	16	16	42	150	4
	4160-150-R50	16	16	42	150	5
	4160-150-R60	16	16	42	150	6
	4180-100-R05	18	20	45	100	0.5
	4180-100-R08	18	20	45	100	0.8
	4180-100-R10	18	20	45	100	1
	4180-100-R15	18	20	45	100	1.5
	4180-100-R20	18	20	45	100	2
	4180-100-R30	18	20	45	100	3
	4180-150-R05	18	20	45	150	0.5
	4180-150-R08	18	20	45	150	0.8
	4180-150-R10	18	20	45	150	1
	4180-150-R15	18	20	45	150	1.5
	4180-150-R20	18	20	45	150	2
	4180-150-R30	18	20	45	150	3

SRES4000 (Radius)



ØD	Tolerance	R Tolerance
Ø1~Ø6	0.00 ~ -0.015	±0.01
Ø6.1~Ø20	0.00 ~ -0.020	±0.01



(mm)

	Designation	ØD	Ød	l	L	r
SRES 4	4200-100-R05	20	20	48	100	0.5
	4200-100-R10	20	20	48	100	1
	4200-100-R15	20	20	48	100	1.5
	4200-100-R20	20	20	48	100	2
	4200-100-R25	20	20	48	100	2.5
	4200-100-R30	20	20	48	100	3
	4200-100-R35	20	20	48	100	3.5
	4200-100-R40	20	20	48	100	4
	4200-100-R50	20	20	48	100	5
	4200-100-R60	20	20	48	100	6
	4200-150-R05	20	20	48	150	0.5
	4200-150-R10	20	20	48	150	1
	4200-150-R15	20	20	48	150	1.5
	4200-150-R20	20	20	48	150	2
	4200-150-R25	20	20	48	150	2.5
	4200-150-R30	20	20	48	150	3
	4200-150-R35	20	20	48	150	3.5
	4200-150-R40	20	20	48	150	4
	4200-150-R50	20	20	48	150	5
	4200-150-R60	20	20	48	150	6



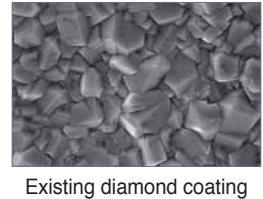
Router endmill for machining composite materials

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 ND2100 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



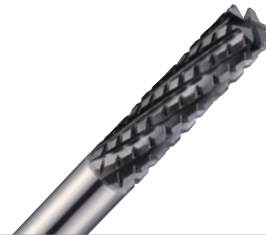
CCDR (Dual Helix Router Endmill)

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



CCHR(High-performance Router Endmill)

- Multi flute nick shaped for high efficient machining
- Endmill for shape contouring, grooving, roughing



CCR (Router Endmill)

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

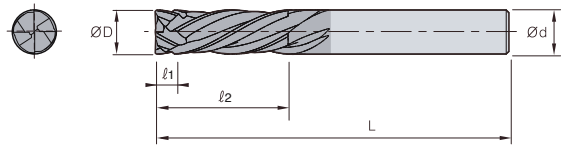


Fig.1

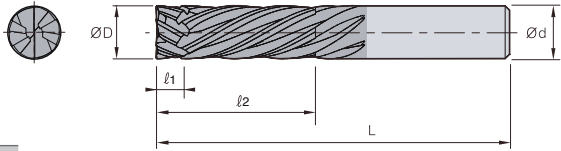


Fig.2



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



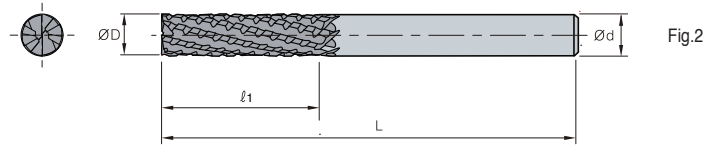
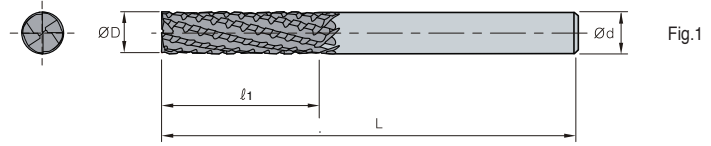
ØD	Tolerance
Ø0.250~0.500	0.0000~-0.0012 inch

(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



CCHR4000/6000 (Flat)



ØD	Tolerance
Ø6~12	0.00 ~ -0.05 mm

Designation		ØD	Ød	ℓ1	L	Fig.
CCHR 4	4060-065	6	6	18	65	1
	4080-075	8	8	24	75	1
CCHR 6	6100-085	10	10	30	85	2
	6120-100	12	12	36	100	2

(mm)

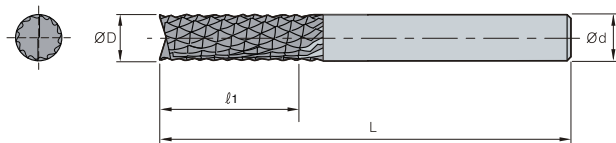


ØD	Tolerance
Ø0.250~0.500	0.0000 ~ -0.002 inch

Designation		ØD	Ød	ℓ1	L	Fig.
CCHR 4	402500	1/4 0.250	0.250	0.750	2.500	1
	402500L	1/4 0.250	0.250	1.500	4.000	1
CCHR 6	603750	3/8 0.375	0.375	1.000	3.250	2
	603750L	3/8 0.375	0.375	1.500	4.000	2
	605000	1/2 0.500	0.500	1.000	3.250	2
	605000L	1/2 0.500	0.500	1.500	4.000	2

(inch)

CCR2000 (Flat)



ØD	Tolerance
Ø4~12	-0.02 ~ -0.08 mm

(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
	2100-085	10	10	30	85
	2120-100	12	12	36	100



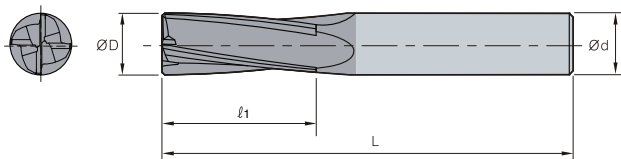
ØD	Tolerance
Ø0.250~0.500	-0.0008 ~ -0.0032 inch

(inch)

Designation		ØD	Ød	l ₁	L
CCR 	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



CCLR4000 (Flat)



ØD	Tolerance
Ø4~12	0.00 ~ -0.03 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

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)

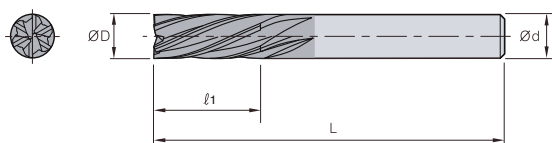


Fig.1

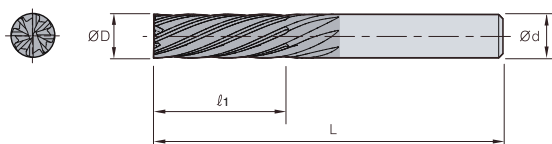


Fig.2



ØD	Tolerance
Ø6~12	0.00 ~ -0.03 mm

(mm)

Designation		ØD	Ød	ℓ1	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

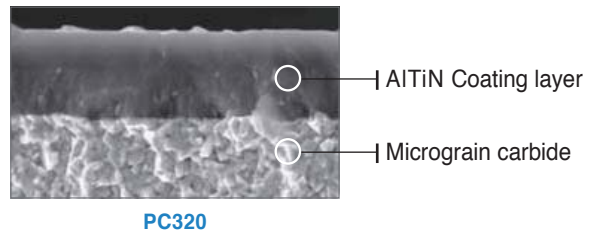
(inch)

Designation		ØD	Ød	ℓ1	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

Stable performance guaranteed for workpiece workpieces under HRC45

I⁺ Endmill

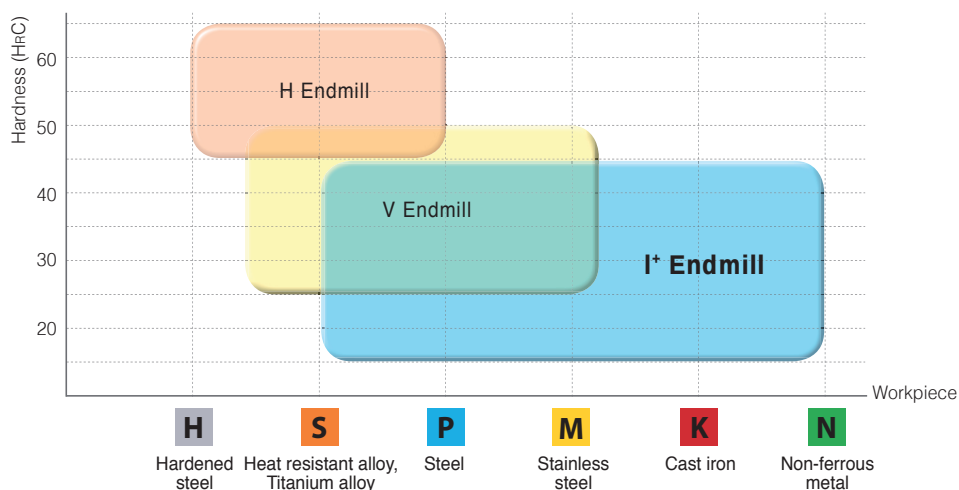
- Tough substrate & wear-resisting coating technology applied
- Wide application range in general use
 - Stable performance guaranteed for workpiece which is under 45HRC
- Saving cost by higher productivity



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

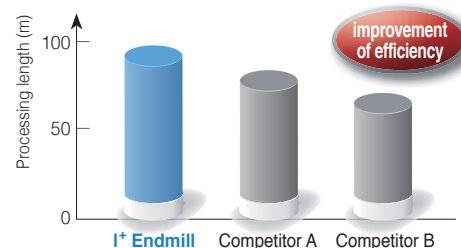


Performance evaluation

- Workpiece SM45C
- Cutting conditions Diameter = Ø8.0, n (min⁻¹) = 5173, vc (m/min) = 130.0, vf (mm/min) = 1034, fz (mm/t) = 0.1, ap (mm) = 0.5, ae (mm) = 1.6, dry
- Tools IPBE2080-060



Test result



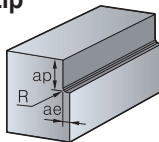
F Technical Information for I⁺ Endmill

Recommended cutting conditions (Flat)

■ IPFE2000

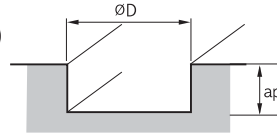
Diameter (ØD)	Carbon steel, Alloy steel~HrC30 (SM50C, SCM, GC250, Cast iron)			Alloy steel, High speed steel HrC30~45 (Pre-hardened steels, STD61, NAK)			Stainless steel (STS304, STS316)		
	R.P.M n (min ⁻¹)	Feed vf (mm/min)		R.P.M n (min ⁻¹)	Feed vf (mm/min)		R.P.M n (min ⁻¹)	Feed vf (mm/min)	
		Shouldering	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)



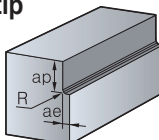
■ Slotting depth (ap)

- ap: ≤ 0.1D (D ≤ Ø2)
≤ 0.2D (D > Ø2)

■ IPFE4000

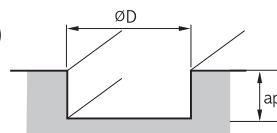
Diameter (ØD)	Carbon steel, Alloy steel ~HrC30 (SM50C, SCM, GC250, Cast iron)			Alloy steel, High speed steel HrC30~45 (Pre-hardened steels, STD61, NAK)			Stainless steel (STS304, STS316)		
	R.P.M n (min ⁻¹)	Feed vf (mm/min)		R.P.M n (min ⁻¹)	Feed vf (mm/min)		R.P.M n (min ⁻¹)	Feed vf (mm/min)	
		Shouldering	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)

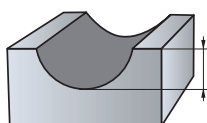


Recommended cutting conditions (Ball)

■ IPBE2000

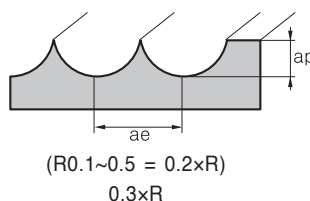
Diameter (ØD)	Carbon steel (SM50C)		Alloy steel (SCM, STD, STS, KP4M, NAK)		Mold steel ~HRC45 (STD61)		Non-ferrous metal (Aluminum)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
1.0	40,000	1,200	38,000	1,200	29,000	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)

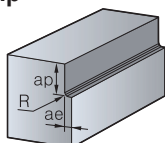
- ~0.16×R R ≤ 0.3 (~45HRC)
- ~0.25×R R ≤ 3 (~45HRC)
- ~0.17×R R ≤ 4 (~45HRC)
- ~0.05×R (~50HRC)

Recommended cutting conditions (Radius)

■ IPRE2000

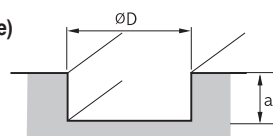
Diameter (ØD)	Carbon steel, Alloy steel ~HRC30 (SM50C, SCM, GC250, Cast iron)			Alloy steel, High speed steel HRC30~45 (Pre-hardened steels, STD61, NAK)			Stainless steel (STS304, STS316)		
	R.P.M n (min ⁻¹)	Feed vf (mm/min)		R.P.M n (min ⁻¹)	Feed vf (mm/min)		R.P.M n (min ⁻¹)	Feed vf (mm/min)	
		Shouldering	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)

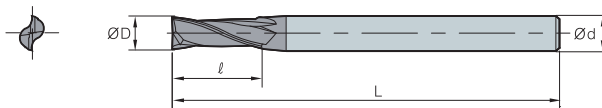
- ap: ≤ 1.5D
- ap: ≤ 0.1D



■ Slotting depth (ap)

- ap: ≤ 0.3D

IPFE2000 (Flat)



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

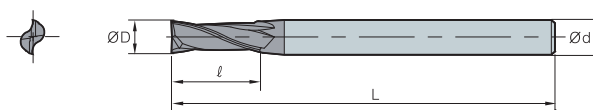


(mm)

	Designation	ØD	Ød	ℓ	L
IPFE 2	2010-050-S3	1	3	3	50
	2010-050-S4	1	4	3	50
	2010-050	1	6	3	50
	2015-050-S3	1.5	3	4	50
	2015-050-S4	1.5	4	4	50
	2015-050	1.5	6	4	50
	2020-050-S3	2	3	6	50
	2020-050-S4	2	4	6	50
	2020-050	2	6	6	50
	2025-050-S3	2.5	3	8	50
	2025-050-S4	2.5	4	8	50
	2025-050	2.5	6	8	50
	2030-050-S3	3	3	8	50
	2030-050-S4	3	4	8	50
	2030-050	3	6	8	50
	2035-050-S4	3.5	4	10	50
	2035-050	3.5	6	10	50
	2040-050-S4	4	4	11	50
	2040-050	4	6	11	50
	2045-050	4.5	6	13	50
	2050-050	5	6	13	50
	2055-050	5.5	6	13	50
	2060-050	6	6	16	50
	2065-060	6.5	8	16	60
	2070-060	7	8	16	60
	2075-060	7.5	8	19	60
	2080-060	8	8	20	60
	2085-075	8.5	10	20	75
	2090-075	9	10	20	75
	2095-075	9.5	10	25	75
	2100-075	10	10	25	75
	2105-075	10.5	12	25	75
	2110-075	11	12	30	75
	2115-075	11.5	12	30	75
	2120-075	12	12	32	75
	2140-100	14	16	40	100
	2160-100	16	16	40	100
	2180-100	18	20	45	100
	2200-100	20	20	45	100



IPLFE2000 (Long flat)



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



Long shank type

(mm)

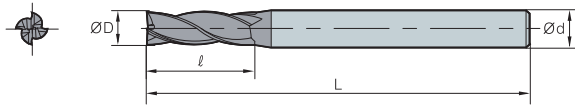
Designation		ØD	Ød	ℓ	L
IPLFE 	2060-075	6	6	16	75
	2060-100	6	6	16	100
	2080-075	8	8	20	75
	2080-100	8	8	20	100
	2100-100	10	10	25	100
	2100-150	10	10	25	150
	2120-100	12	12	32	100
	2120-150	12	12	32	150

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

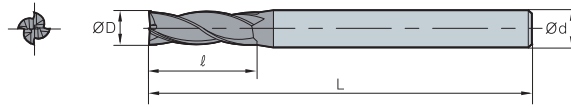


(mm)

	Designation	ØD	Ød	ℓ	L
IPFE 4	4010-050-S3	1	3	3	50
	4010-050-S4	1	4	3	50
	4010-050	1	6	3	50
	4015-050-S3	1.5	3	4	50
	4015-050-S4	1.5	4	4	50
	4015-050	1.5	6	4	50
	4020-050-S3	2	3	6	50
	4020-050-S4	2	4	6	50
	4020-050	2	6	6	50
	4025-050-S3	2.5	3	8	50
	4025-050-S4	2.5	4	8	50
	4025-050	2.5	6	8	50
	4030-050-S3	3	3	8	50
	4030-050-S4	3	4	8	50
	4030-050	3	6	8	50
	4035-050-S4	3.5	4	10	50
	4035-050	3.5	6	10	50
	4040-050-S4	4	4	11	50
	4040-050	4	6	11	50
	4045-050	4.5	6	13	50
	4050-050	5	6	13	50
	4055-050	5.5	6	13	50
	4060-050	6	6	16	50
	4065-060	6.5	8	16	60
	4070-060	7	8	16	60
	4075-060	7.5	8	19	60
	4080-060	8	8	20	60
	4085-075	8.5	10	20	75
	4090-075	9	10	20	75
	4095-075	9.5	10	25	75
	4100-075	10	10	30	75
	4105-075	10.5	12	30	75
	4110-075	11	12	30	75
	4115-075	11.5	12	30	75
	4120-075	12	12	32	75
	4140-100	14	16	40	100
	4160-100	16	16	40	100
	4180-100	18	20	45	100
	4200-100	20	20	45	100



IPLFE4000 (Long flat)



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



Long shank type

(mm)

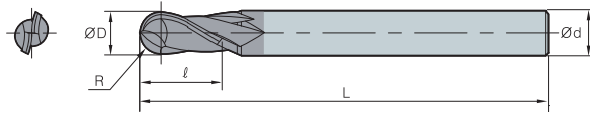
Designation		ØD	Ød	ℓ	L
 IPLFE	4060-075	6	6	16	75
	4060-100	6	6	16	100
	4080-075	8	8	20	75
	4080-100	8	8	20	100
	4100-100	10	10	30	100
	4100-150	10	10	30	150
	4120-100	12	12	32	100
	4120-150	12	12	32	150

Long flute type

(mm)

Designation		ØD	Ød	ℓ	L
IPLFE 4	4010-050-V6S4	1	4	6	50
	4015-050-V9S4	1.5	4	9	50
	4020-050-V12S4	2	4	12	50
	4025-050-V12S4	2.5	4	12	50
	4030-060-V15S6	3	6	15	60
	4035-060-V15S6	3.5	6	15	60
	4040-075-V20S6	4	6	20	75
	4045-075-V20S6	4.5	6	20	75
	4050-075-V25S6	5	6	25	75
	4055-075-V25S6	5.5	6	25	75
	4060-075-V30S6	6	6	30	75
	4070-100-V30S8	7	8	30	100
	4080-100-V40S8	8	8	40	100
	4090-100-V40S10	9	10	40	100
	4100-100-V40S10	10	10	40	100
	4110-100-V40S12	11	12	40	100
	4120-100-V50S12	12	12	50	100
	4140-150-V50S16	14	16	50	150
	4160-150-V60S16	16	16	60	150
	4200-200-V90S20	20	20	90	200

IPBE2000 (Ball)



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

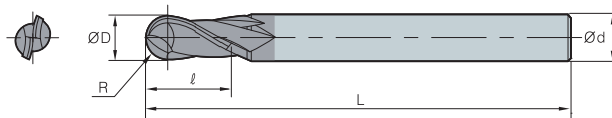


(mm)

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)



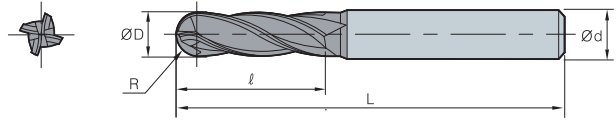
ØD	Tolerance
Ø1~Ø12	0.00~ -0.02
Ø12.1~Ø16	0.00~ -0.03



(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

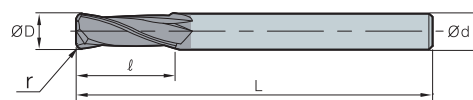


(mm)

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)



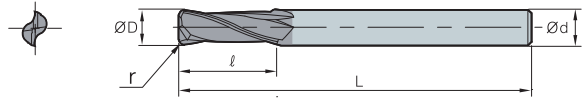
ØD	Tolerance
Ø1~Ø12	0.00~-0.02



(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

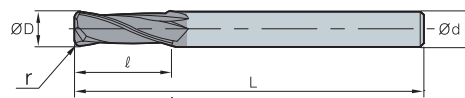


(mm)

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)



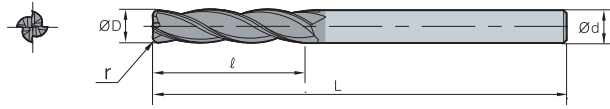
ØD	Tolerance
Ø3~Ø12	0.00~-0.02



(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

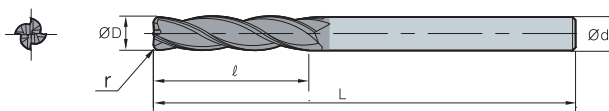


(mm)

	Designation	ØD	Ød	ℓ	L	r
IPRE	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
4	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

F Technical Information for Z⁺ Endmill

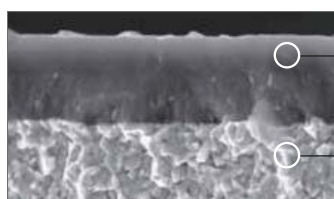
Highly efficient and economical endmill for general cutting

Z⁺ Endmill

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

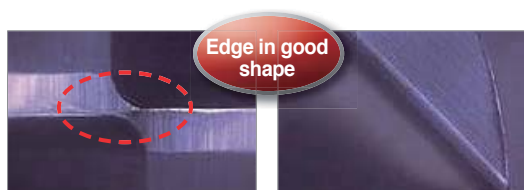
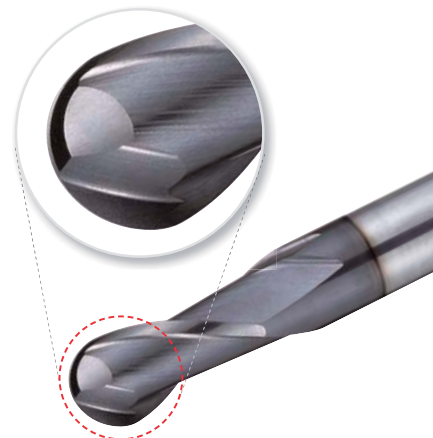
Features

- 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

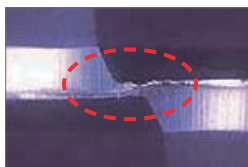
- AICrSiN coating layer
: Coating lubrication making possible high temperature/high speed machining
- Ultra-fine substrate
: Substrate with excellent wear resistance applied



Edge in good shape

Z⁺ Endmill

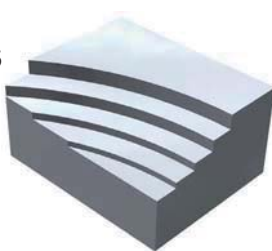
Exceptional cutting edge rigidity



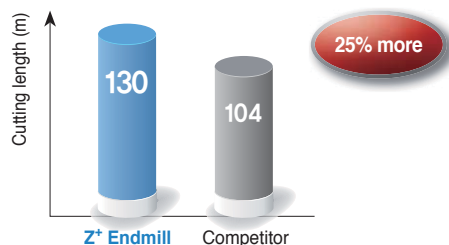
Competitor

Application examples

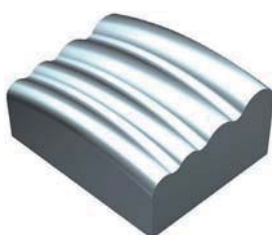
- **Workpiece** Carbon steel (C45, ~H_RC20)
- **Cutting conditions** vc (m/min) = 180, fz (mm/t) = 0.05
ap (mm) = 8, dry
- **Tools** ZPFE4080-060



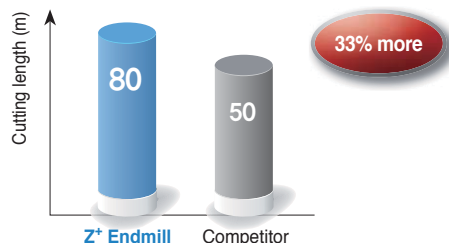
Test result



- **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



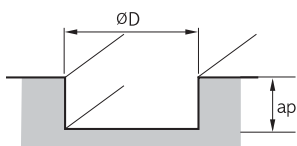
Test result



Recommended cutting conditions (ZPFE2000/ZPSFE2000 Flat)

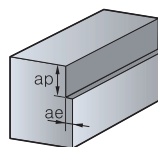
Workpiece Cutting conditions Diameter (Ø)	Alloy steel and Carbon steel (under HRC30)		Pre-hardened steel, Mold steel (HRC30~47)		Stainless steel	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
1	19,745	175	13,057	100	10,500	70
2	11,560	190	7,560	120	6,300	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)

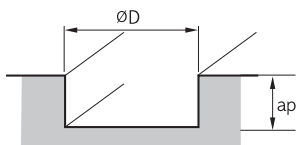
- $D \leq \varnothing 2.5$ ($ap = 1.5D$, $ae = 0.05D$)
- $D > \varnothing 2.5$ ($ap = 1.5D$, $ae = 0.1D$)

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

Recommended cutting conditions (ZPFE4000/ZPSFE4000 Flat)

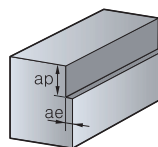
Workpiece Cutting conditions Diameter (Ø)	Alloy steel and Carbon steel (under HRC30)		Pre-hardened steel, Mold steel (HRC30~47)		Stainless steel	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
2	11,560	280	7,560	170	6,300	140
3	8,920	320	5,560	200	4,620	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)

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

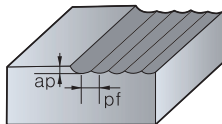
* Workpiece should be clamped rigidly. In case of vibrations, reduce RPM and feed rate by the same ratio

F Technical Information for Z⁺ Endmill

Recommended cutting conditions (ZPBE2000 Ball)

Workpiece Cutting conditions Diameter (Ø)	Alloy steel and Carbon steel (under HRC30)		Pre-hardened steel, Mold 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



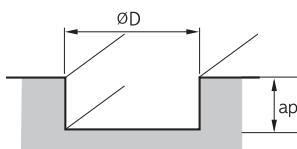
- $ap = 0.03D$
- $pf = 0.05D$

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

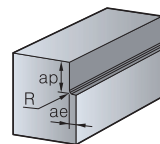
Recommended cutting conditions (ZPRE2000 Radius)

Workpiece Cutting conditions Diameter (Ø)	Alloy steel and Carbon steel (under HRC30)		Pre-hardened steel, Mold 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)
- $ap \leq 0.3D$



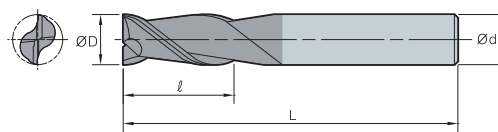
- Shouldering depth (ap)
- $ap \leq 1.5D$
- $ae \leq 0.1D$

* 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)

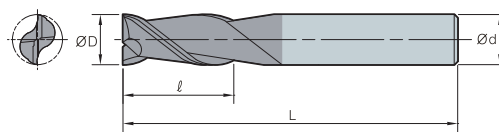
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	ØD	Ød	ℓ	L
ZPFE				
2 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)



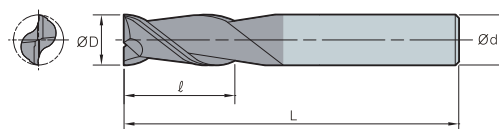
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	ØD	Ød	ℓ	L
ZPSFE				
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

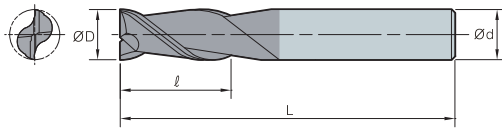


(mm)

Designation	ØD	Ød	ℓ	L
ZPLFE				
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)



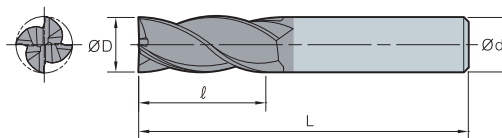
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(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)



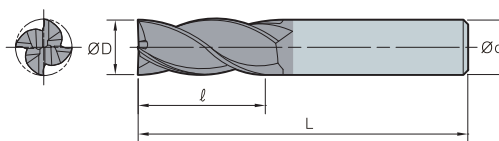
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	ØD	Ød	ℓ	L
ZPFE				
4 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)

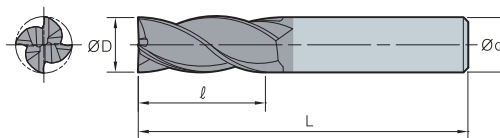
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(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

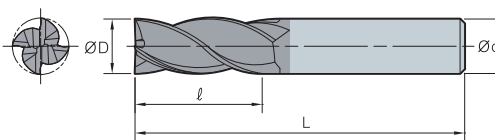


(mm)

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)



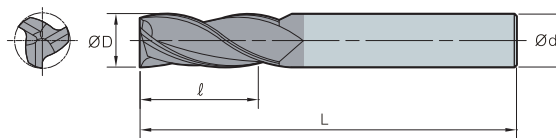
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

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

ZPFE3000 (Flat)



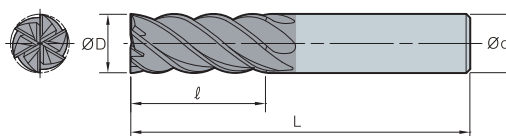
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	ØD	Ød	ℓ	L
ZPFE 3	3020-050-S4	2.0	4	6
	3030-050-S4	3.0	4	9
	3040-050-S4	4.0	4	11
	3050-050	5.0	6	13
	3060-050	6.0	6	16
	3065-060	6.5	8	16
	3080-060	8.0	8	20
	3095-075	9.5	10	24
	3100-075	10.0	10	25
	3120-075	12.0	12	30
	3106-100	16.0	16	36
	3180-100	18.0	18	40
	3200-100	20.0	20	45
	3250-100	25.0	25	50

ZPFE6000 (Flat)

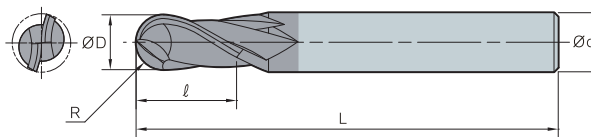


ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

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

ZPBE2000 (Ball)

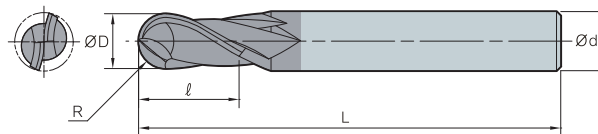
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(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)



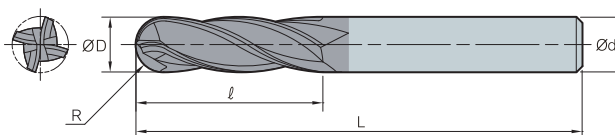
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(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

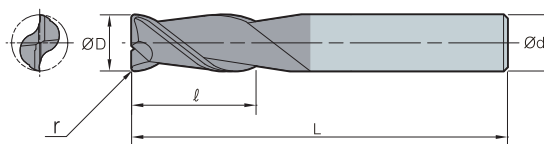


(mm)

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)



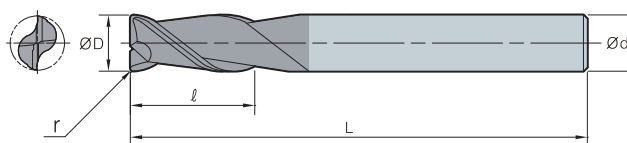
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation		ØD	Ød	ℓ	L	r
ZPRE 2	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-R010	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

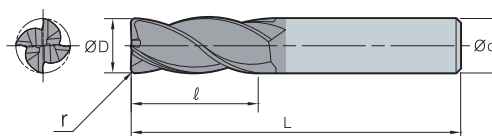


(mm)

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)



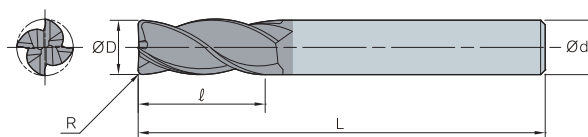
ØD	Tolerance
~Ø11.9	0.00~ -0.02
Ø12~	0.00~ -0.03



(mm)

Designation	ØD	Ød	l	L	r
ZPRE					
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

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

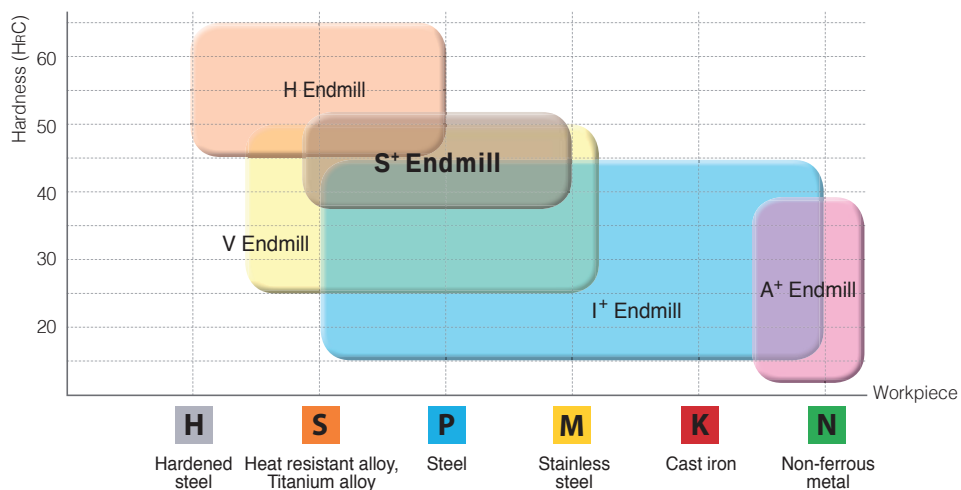


Endmill for Stainless steel machining

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

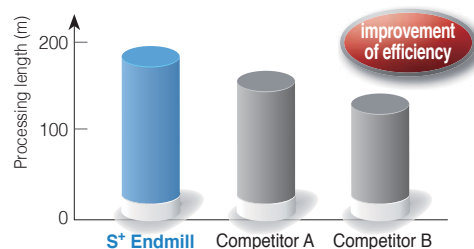


S⁺ Endmill

Competitor A

Competitor B

Test result

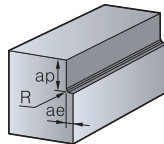


F Technical Information for S⁺ Endmill

Recommend cutting conditions

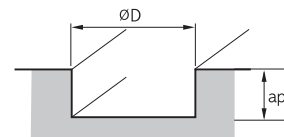
Workpiece Condition	Stainless steel STS		Titanium alloy /Inconel		Normal steel (SS, SM) (Under HRC 25)		Alloy steel (SCM) (HRC 25~35)		Hardened steel (STD) (HRC 40~50)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
Diameter (Ø)										
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: $ap = 1.5D$, $ae = 0.1D$
- Titanium alloy, Inconel, Hardened steel: $ap = 1.5D$, $ae = 0.05D$



■ 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

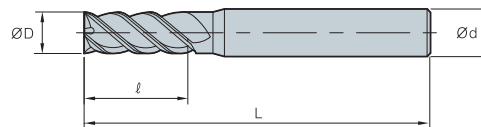
- Low thermal conductivity of stainless steel alloy causes conducting heat to the tool and fracture and chipping
- Stainless steel alloy has high cutting resistance, and it easily causes wear on tools
- High temperature in stainless steel alloy machining lowers cutting conditions and decrease the quality 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)

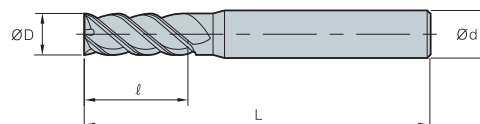


ØD	Tolerance
Ø1~Ø12	0.00~-0.02

Designation		ØD	Ød	ℓ	L
SPFE	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

(mm)

SPLFE4000 (Long flat)



ØD	Tolerance
Ø1~Ø12	0.00~-0.02

Designation		ØD	Ød	ℓ	L
SPLFE	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

(mm)

F Technical Information for R⁺ Endmill

High efficient roughing endmill

R⁺ Endmill new

- Cost-effective cutting-edge design for rough machining
- Decreased cutting load by implementing specifically designed edges, irregular flute spacing, and unequal 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

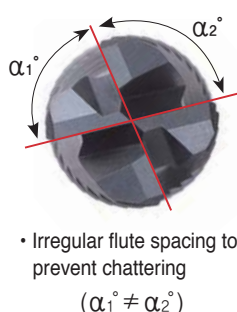


Lower cutting load

- Ideal for medium to rough cutting
- Special edge design

Smooth cutting

- Serrated cutting edges
- 3 Combo R

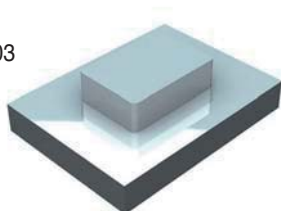


Grade system

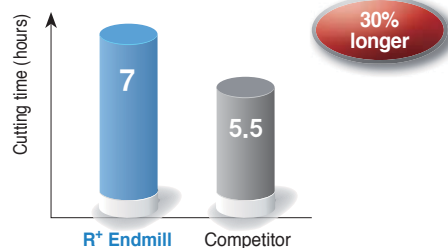
Carbide roughing		HSS roughing	
FN30T	Carbide, uncoated	HN30T	HSS PM, uncoated
PC10T	Carbide, TiCN coated	HN20T	HSS, uncoated
PC20T	Carbide, TiN coated	HC10T	HSS, TiCN coated
PC30T	Carbide, TiAlN coated	HC20T	HSS, TiN coated
PC40T	Carbide, TiAlCrN coated	HC30T	HSS PM, TiAlN coated

Application examples

- **Workpiece** Mold
- **Cutting conditions** vc (m/min) = 57, fz (mm/t) = 0.03
ap (mm) = 8, dry
- **Tools** RPE4080-075-FF



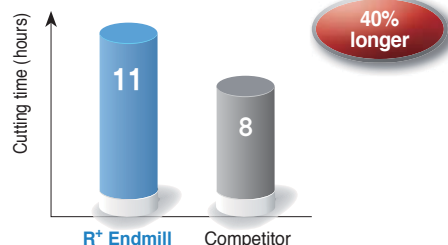
Test result



- **Workpiece** Mold
- **Cutting conditions** vc (m/min) = 68, fz (mm/t) = 0.06
ap (mm) = 8, dry
- **Tools** RPE4080-063-FP-H



Test result

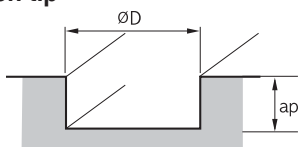


Recommended cutting conditions (RPAE)

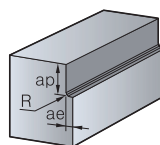
*For Carbide

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)
 - $ap : \leq 0.2D$



- Shouldering depth (ap)
 - $ap : \leq 1.5D$
 - $ae : \leq 0.15D$

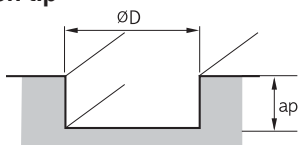
* Workpiece should be clamped rigidly. In case of vibrations, reduce R.P.M and feed rate by the same ratio

Recommended cutting conditions (RP(L)E-FP-H)

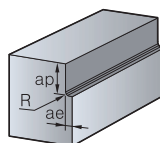
*For Carbide

Workpiece Conditions Diameter (Ø)	Alloy steel, Carbon steel ($\leq HRC25$)		Alloy steel, Carbon steel, Pre-hardened steel ($HRC25 \sim HRC40$)		Alloy steel, Carbon steel ($\leq HRC25$)		Alloy steel, Carbon steel, Pre-hardened steel ($HRC25 \sim HRC40$)	
	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)
 - $ap : \leq 1.0D$ ($\leq HRC25$)
 - $\leq 0.8D$ ($HRC25 \sim 40$)



- Shouldering depth (ap)
 - $ap : \leq 1.0D$
 - $ae : \leq 0.5D$ ($\leq HRC25$)
 - $\leq 0.35D$ ($HRC25 \sim 40$)

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

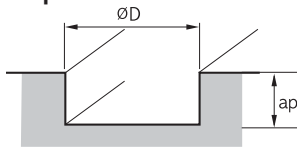
F Technical Information for R⁺ Endmill

Recommended cutting conditions (RPE-XG)

* For Carbide

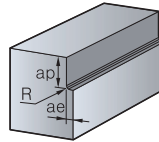
Workpiece Conditions Diameter (Ø)	Alloy steel, Carbon steel (≤ HRC25)		Alloy steel, Carbon steel, Pre-hardened steel (HRC25~HRC40)		Alloy steel, Carbon steel (≤ HRC25)		Alloy steel, Carbon steel, Pre-hardened steel (HRC25~HRC40)	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	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)

- $ap: \leq 1.0D (\leq \text{HRC}25)$
- $\leq 0.8D (\text{HRC}25\sim40)$



Shouldering depth (ap)

- $ap: \leq 1.0D$
- $ae: \leq 0.5D (\leq \text{HRC}25)$
- $\leq 0.35D (\text{HRC}25\sim40)$

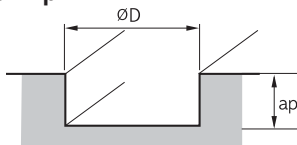
* Workpiece should be clamped rigidly. In case of vibrations, reduce R.P.M and feed rate by the same ratio

Recommended cutting conditions (RPE-FP-L)

* For Carbide

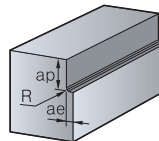
Workpiece Conditions Diameter (Ø)	Alloy steel, Carbon steel (≤ HRC35)		Pre-hardened steel (HRC35~HRC45)		High hardened steel (HRC45~HRC55)	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
6	12,400	840	8,400	570	3,400	260
8	9,200	840	6,300	570	2,400	240
10	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)

- $ap: \leq 0.3D (\leq \text{HRC}45)$
- $\leq 0.05D (\text{HRC}45\sim55)$



Shouldering depth (ap)

- $ap: \leq 1.0D$
- $ae: \leq 0.3D (\leq \text{HRC}45)$
- $\leq 0.05D (\text{HRC}45\sim55)$

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

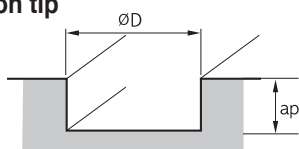


Recommended cutting conditions (RPE-RG)

*For Carbide

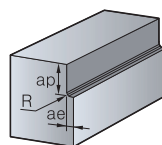
Workpiece Conditions Diameter (Ø)	Alloy steel, Carbon steel (≤ HRC25)		Alloy steel, Carbon steel, Pre-hardened steel (HRC25~HRC40)		Alloy steel, Carbon steel (≤ HRC25)		Alloy steel, Carbon steel, Pre-hardened steel (HRC25~HRC40)	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed vf (mm/min)
6	12,000	1,240	10,600	880	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)

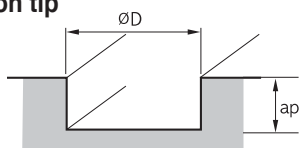
* Workpiece should be clamped rigidly. In case of vibrations, reduce R.P.M and feed rate by the same ratio

Recommended cutting conditions (RPE-FF, FP, RG)

*For HSS PM

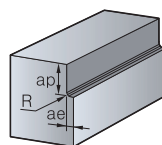
Workpiece Conditions Diameter (Ø)	Alloy steel, Carbon steel, High speed steel		Alloy steel, Carbon steel, High speed steel (≤ HRC20)		Alloy steel, Carbon steel, High speed steel (HRC20~HRC30)		Alloy steel, Carbon steel, High speed steel (HRC30~HRC40)	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed 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

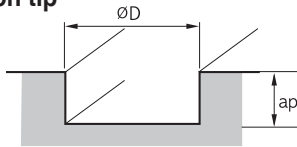
F Technical Information for R⁺ Endmill

Recommended cutting conditions (RPE-RG)

* For HSS Co

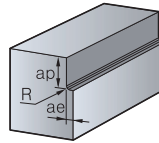
Workpiece Conditions Diameter (Ø)	Alloy steel, Carbon steel, High speed steel		Alloy steel, Carbon steel, High speed steel (≤ HRC20)		Alloy steel, Carbon steel, High speed steel (HRC20~HRC30)		Alloy steel, Carbon steel, High speed steel (HRC30~HRC40)	
	RPM n (min-1)	Feed vf (mm/min)	RPM n (min-1)	Feed 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)

- $ap: \leq 0.15D$



Shouldering depth (ap)

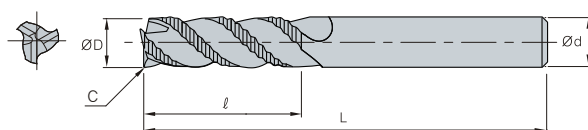
- $ap: \leq 1.5D$
- $ae: \leq 0.1D$

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



RPAE (Wave roughing endmill for Al)

Carbide

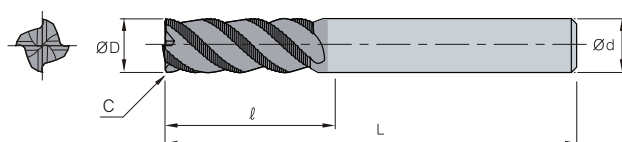


ØD	Tolerance
Ø6 ~ Ø25	0.00 ~ -0.05



(mm)

Designation		ØD	Ød	ℓ	L	C
RPAE 3	3060-063	6.0	6	18	63	0.3
	3070-063	7.0	8	23	63	0.3
	3080-063	8.0	8	23	63	0.3
	3090-080	9.0	10	30	80	0.3
	3100-080	10.0	10	30	80	0.3
	3110-080	11.0	12	32	80	0.5
	3120-080	12.0	12	32	80	0.5
	3140-080	14.0	14	32	80	0.5
	3160-105	16.0	16	48	105	0.5
	3180-105	18.0	18	48	105	0.5
	3200-105	20.0	20	50	105	0.5
	3250-105	25.0	25	50	105	0.5

RPE-FP-H (Fine pitch standard type roughing endmill)Carbide, High helix angle,
irregular flute spacing and lead

ØD	Tolerance
Ø5 ~ Ø20	0.00 ~ -0.05

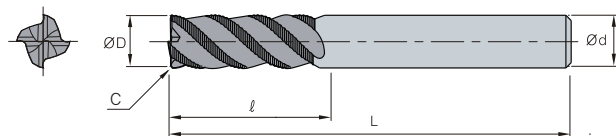


(mm)

Designation		ØD	Ød	ℓ	L	C
 RPE 4	4050-057-FP-H	5.0	6	13	57	0.3
	4060-057-FP-H	6.0	6	13	57	0.5
	4080-063-FP-H	8.0	8	19	63	0.5
	4100-072-FP-H	10.0	10	22	72	0.5
	4120-082-FP-H	12.0	12	26	82	0.5
	4140-082-FP-H	14.0	16	26	82	0.6
	4160-092-FP-H	16.0	16	32	92	0.6
	4180-092-FP-H	18.0	20	32	92	0.6
	4200-0104-FP-H	20.0	20	38	104	0.6

RPLE-FP-H (Fine pitch long type roughing endmill)

Carbide, High helix angle, irregular flute spacing and lead



ØD	Tolerance
Ø5 ~ Ø20	0.00 ~ -0.05

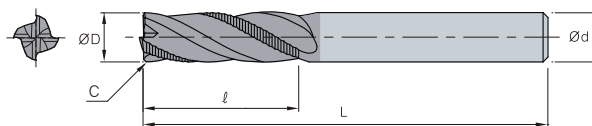


(mm)

Designation	ØD	Ød	ℓ	L	C
RPLE					
4050-063-FP-H	5.0	6	19	63	0.3
4060-063-FP-H	6.0	8	19	63	0.5
4080-072-FP-H	8.0	8	28	72	0.5
4100-082-FP-H	10.0	10	34	82	0.5
4120-097-FP-H	12.0	12	40	97	0.5
4140-097-FP-H	14.0	16	40	97	0.6
4160-108-FP-H	16.0	16	48	108	0.6
4180-108-FP-H	18.0	20	48	108	0.6
4200-122-FP-H	20.0	20	56	122	0.6

RPE-XG (Endmill for finishing and roughing)

Carbide



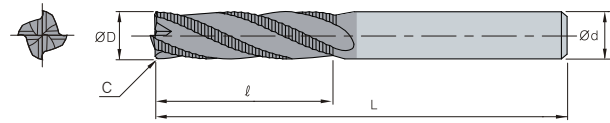
ØD	Tolerance
Ø6 ~ Ø20	0.00 ~ -0.05



(mm)

Designation	ØD	Ød	ℓ	L	C
RPE					
4060-052-XG	6.0	6	14	52	0.25
4070-063-XG	7.0	8	18	63	0.3
4080-063-XG	8.0	8	18	63	0.3
4090-080-XG	9.0	10	22	80	0.3
4100-080-XG	10.0	10	22	80	0.3
4110-080-XG	11.0	12	26	80	0.4
4120-080-XG	12.0	12	26	80	0.4
4140-080-XG	14.0	14	30	80	0.4
4160-105-XG	16.0	16	34	105	0.6
4180-105-XG	18.0	18	38	105	0.6
4200-105-XG	20.0	20	42	105	0.6



RPE-FP-L (Roughing endmill for fine pitches)Carbide,
irregular flute spacing and lead

ØD	Tolerance
Ø5 ~ Ø20	0.00 ~ -0.05

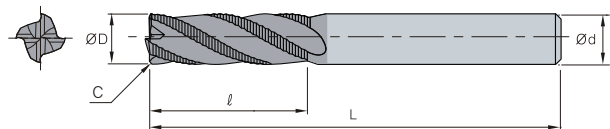


(mm)

Designation		ØD	Ød	ℓ	L	C
RPE 4	4050-060-FP-L	5.0	6	13	60	0.3
	4060-080-FP-L	6.0	8	13	80	0.5
	4080-080-FP-L	8.0	8	19	80	0.5
	4100-080-FP-L	10.0	10	22	80	0.5
	4120-080-FP-L	12.0	12	26	80	0.5
	4140-085-FP-L	14.0	16	26	85	0.6
	4160-100-FP-L	16.0	16	32	100	0.6
	4180-100-FP-L	18.0	20	32	100	0.6
	4200-105-FP-L	20.0	20	38	105	0.6

RPE-RG (Standard roughing endmill)

Carbide



ØD	Tolerance
Ø5 ~ Ø20	0.00 ~ -0.05

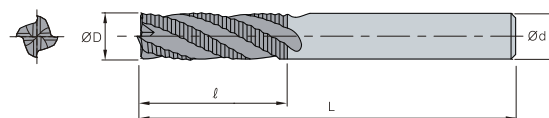


(mm)

Designation		ØD	Ød	ℓ	L	C
RPE 4	4050-050-RG	5.0	6	13	50	0.3
	4060-050-RG	6.0	6	16	50	0.3
	4080-060-RG	8.0	8	20	60	0.3
	4100-075-RG	10.0	10	25	75	0.3
	4120-080-RG	12.0	12	30	80	0.4
	4140-100-RG	14.0	16	35	100	0.6
	4160-100-RG	16.0	16	40	100	0.6
	4180-110-RG	18.0	20	40	110	0.6
	4200-110-RG	20.0	20	45	110	0.6

RPE-RG (4F roughing endmill)

HSS PM



ØD	Tolerance
Ø6 ~ Ø20	±0.1

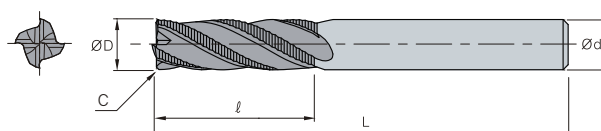


(mm)

Designation	ØD	Ød	ℓ	L
RPE				
4060-060-RG	6.0	6	20	60
4070-070-RG	7.0	10	20	70
4080-075-RG	8.0	10	25	75
4090-075-RG	9.0	10	30	75
4100-085-RG	10.0	10	35	85
4120-100-RG	12.0	12	40	100
4140-100-RG	14.0	16	40	100
4160-110-RG	16.0	16	50	110
4180-110-RG	18.0	20	50	110
4200-125-RG	20.0	20	60	125

RPE-FF (Roughing endmill for fine pitches)

HSS PM, Irregular flute spacing



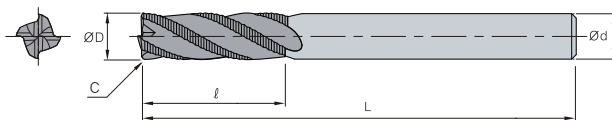
ØD	Tolerance
Ø6 ~ Ø20	±0.1



(mm)

Designation	ØD	Ød	ℓ	L	C
RPE					
4060-060-FF	6.0	6	20	60	0.5
4070-070-FF	7.0	10	20	70	0.5
4080-075-FF	8.0	10	25	75	0.5
4090-075-FF	9.0	10	30	75	0.5
4100-085-FF	10.0	10	35	85	0.5
4120-100-FF	12.0	12	40	100	0.6
4140-100-FF	14.0	12	40	100	0.6
4160-110-FF	16.0	16	50	110	0.6
4180-110-FF	18.0	16	50	110	0.6
4200-125-FF	20.0	20	60	125	0.6



RPE-FP (Roughing endmill for fine pitches)HSS PM,
irregular flute spacing and lead

ØD	Tolerance
Ø6 ~ Ø12.0	0.00 ~ -0.05
Ø12.1 ~ Ø20.0	0.00 ~ -0.1

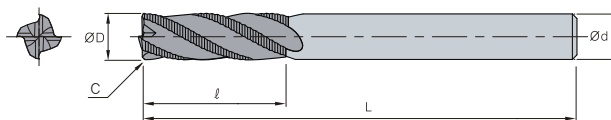


(mm)

Designation		ØD	Ød	ℓ	L	C
RPE 	4060-080-FP	6.0	6	13	80	0.5
	4070-080-FP	7.0	10	16	80	0.5
	4080-085-FP	8.0	10	19	85	0.5
	4090-095-FP	9.0	10	19	95	0.5
	4100-100-FP	10.0	10	22	100	0.5
	4120-110-FP	12.0	12	26	110	0.6
	4140-110-FP	14.0	12	26	110	0.6
	4160-125-FP	16.0	16	32	125	0.6
	4180-125-FP	18.0	16	32	125	0.6
	4200-140-FP	20.0	20	38	140	0.6

RPE-RG (Roughing endmill)

HSS



ØD	Tolerance
Ø6 ~ Ø50	±0.1



(mm)

Designation	ØD	Ød	ℓ	L
RPE				
4060-060-RG	6.0	6	15	60
4070-065-RG	7.0	8	20	65
4080-065-RG	8.0	8	20	65
4090-075-RG	9.0	10	25	75
4100-075-RG	10.0	10	25	75
4110-080-RG	11.0	12	30	80
4120-080-RG	12.0	12	30	80
4130-090-RG	13.0	12	35	90
4140-090-RG	14.0	12	35	90
4150-095-RG	15.0	12	40	95
4160-095-RG	16.0	16	40	95
4170-095-RG	17.0	16	40	95
4180-105-RG	18.0	16	40	105
4190-110-RG	19.0	16	45	110
4200-110-RG	20.0	20	45	110
4210-110-RG	21.0	20	45	110
4220-110-RG	22.0	20	45	110
4230-110-RG	23.0	20	45	110
4240-120-RG	24.0	25	50	120
4250-120-RG	25.0	25	50	120
4260-120-RG	26.0	25	50	120
4270-125-RG	27.0	25	55	125
4280-125-RG	28.0	25	55	125
4300-125-RG	30.0	25	55	125
4320-145-RG	32.0	32	60	145
4340-145-RG	34.0	32	60	145
4350-145-RG	35.0	32	60	145
4360-145-RG	36.0	32	60	145
4380-150-RG	38.0	32	65	150
4400-150-RG	40.0	32	65	150
4420-155-RG	42.0	42	65	155
4440-155-RG	44.0	42	65	155
4450-160-RG	45.0	42	70	160
4460-160-RG	46.0	42	70	160
4500-160-RG	50.0	42	70	160

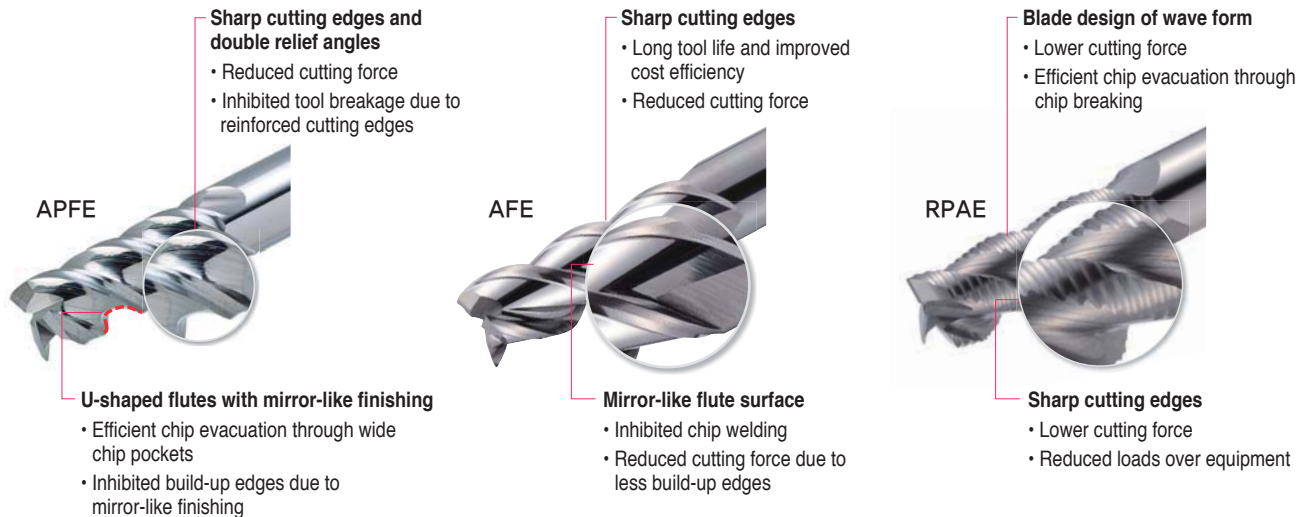


Endmill series for aluminum machining

A⁺ Endmill

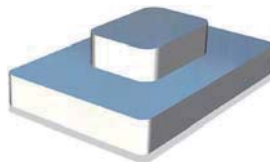
- Endmills for rough, medium to finish cutting of aluminum
- Optimized solutions for each application type - A wide selection of tools provided for various machining processes
- Higher machining efficiency - advanced flute design and cutting edge technology applied

Features

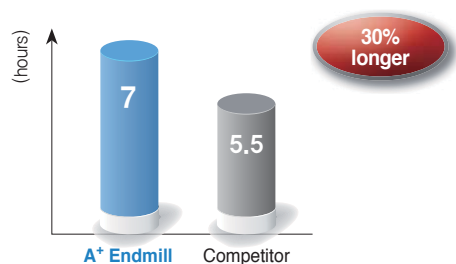


Application examples

- **Workpiece** Jig (A7075)
- **Cutting conditions** vc (m/min) = 200, fz (mm/t) = 0.05
 ap (mm) = 8, ae (mm) = 2, wet
- **Tools** APFE3080-060



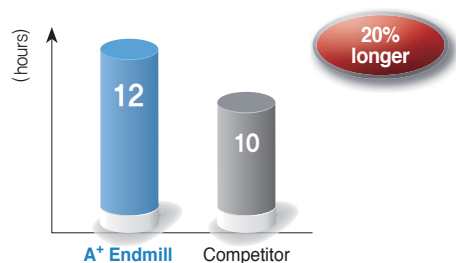
Test result



- **Workpiece** Inside milling of smart phones (Al60 series)
- **Cutting conditions** vc (m/min) = 65, fz (mm/t) = 0.02
 ap (mm) = 1, ae (mm) = 1, wet
- **Tools** AFE3010-050-V3S6



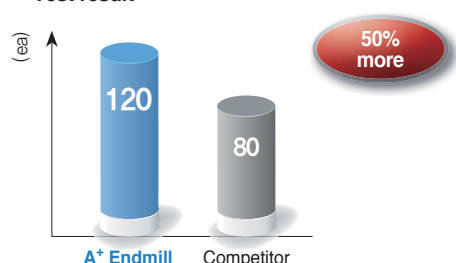
Test result



- **Workpiece** Roughing aluminum rectangular tubes (Al70 series)
- **Cutting conditions** vc (m/min) = 330, fz (mm/t) = 0.05
 ap (mm) = 15, ae (mm) = 1.5, dry
- **Tools** RPAE3100-080



Test result

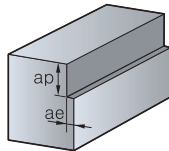


F Technical Information for A⁺ Endmill

Recommended Cutting Conditions (APFE/AFE)

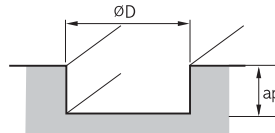
Workpiece Conditions Diameter (Ø)	Shouldering				Slotting			
	Aluminum alloy (A7075)		Aluminum alloy mold (AC4B)		Aluminum alloy (A7075)		Aluminum alloy mold (AC4B)	
	RPM n (min ⁻¹)	Feed vf (mm/min)	RPM n (min ⁻¹)	Feed vf (mm/min)	RPM n (min ⁻¹)	Feed vf (mm/min)	RPM n (min ⁻¹)	Feed vf (mm/min)
1	40,000	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)

- $ap : \leq 2,0D$
- $ae : \leq 0,2D (D < \varnothing 3)$
 $: \leq 0,5D (D \geq \varnothing 3)$



Slotting depth (ap)

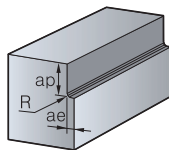
- $ap : \leq D$ (Maximum 12 mm)

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

Recommended Cutting Conditions (RPAE/APRE)

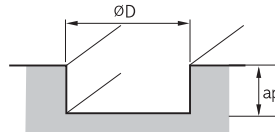
Workpiece Conditions Diameter (Ø)	Shouldering				Slotting			
	Aluminum alloy (A7075)		Aluminum alloy mold (AC4B)		Aluminum alloy (A7075)		Aluminum alloy mold (AC4B)	
	RPM n (min ⁻¹)	Feed vf (mm/min)	RPM n (min ⁻¹)	Feed vf (mm/min)	RPM n (min ⁻¹)	Feed vf (mm/min)	RPM n (min ⁻¹)	Feed vf (mm/min)
4	20,000	8,000	16,000	6,400	15,000	5,000	12,000	4,000
5	16,000	6,500	12,800	5,200	12,000	4,000	9,600	3,200
6	13,500	6,000	10,800	4,800	10,500	3,800	8,400	3,100
8	10,500	4,700	8,400	3,800	8,000	3,000	6,400	2,400
10	8,500	3,800	6,800	3,100	6,500	2,500	5,200	2,000
12	6,800	3,050	5,500	2,500	5,250	2,000	4,200	1,600
14	5,800	2,600	4,700	2,100	4,500	1,700	3,600	1,400
16	5,200	2,350	4,200	1,900	4,000	1,500	3,200	1,200
18	4,700	2,100	3,800	1,700	3,550	1,300	2,900	1,100
20	4,200	1,900	3,400	1,600	3,200	1,200	2,600	1,000
25	3,400	1,500	2,800	1,200	2,550	1,000	2,100	800

Application tip



Shouldering depth (ap)

- $ap : \leq 1,5D$
- $ae : \leq 0,5D$



Slotting depth (ap)

- $ap : \leq 1,5D$

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



APFE2000/3000 (Flat)

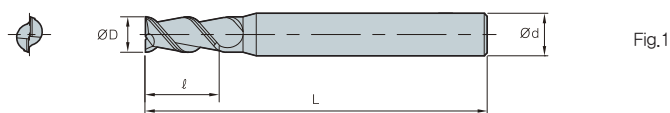


Fig.1

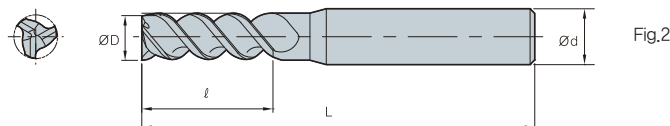


Fig.2



ØD	Tolerance
Ø1 ~ Ø6	-0.00 ~ -0.02
Ø6.1 ~ Ø8	-0.00 ~ -0.025
Ø8.1 ~ Ø20	-0.00 ~ -0.03



(mm)

Designation		ØD	Ød	ℓ	L	Fig.
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	2.5	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
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

APMFE2000/3000 (Middle flat)

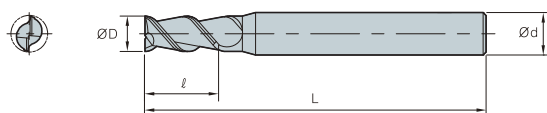


Fig.1

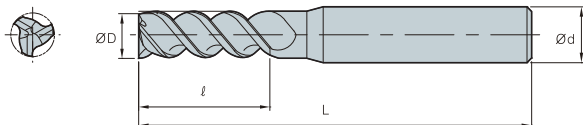


Fig.2



ØD	Tolerance
Ø1 ~ Ø6	0.00 ~ 0.02
Ø6.1 ~ Ø8	0.00 ~ 0.025
Ø8.1 ~ Ø20	0.00 ~ 0.03



(mm)

Designation		ØD	Ød	ℓ	L	Fig.
APMFE 2	2030-060	3.0	6	11	60	1
	2040-060	4.0	6	14	60	1
	2050-060	5.0	6	17	60	1
	2060-065	6.0	6	22	65	1
	2080-065	8.0	8	25	65	1
	2100-080	10.0	10	37	80	1
	2120-080	12.0	12	40	80	1
	2160-110	16.0	16	55	110	1
	2200-125	20.0	20	60	125	1
APMFE 3	3030-060	3.0	6	11	60	2
	3040-060	4.0	6	14	60	2
	3050-060	5.0	6	17	60	2
	3060-065	6.0	6	22	65	2
	3080-065	8.0	8	25	65	2
	3100-080	10.0	10	37	80	2
	3120-080	12.0	12	40	80	2
	3160-110	16.0	16	55	110	2
	3200-125	20.0	20	60	125	2

APLFE2000/3000 (Long flat)

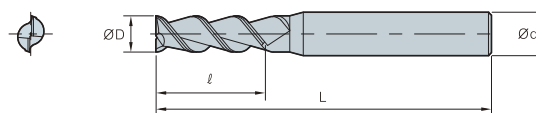


Fig.1

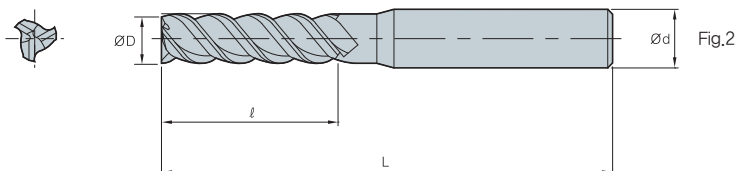


Fig.2



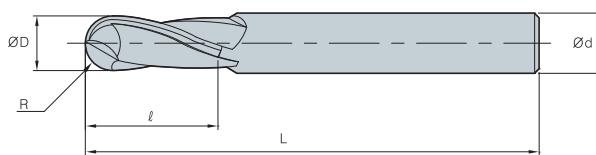
ØD	Tolerance
Ø1 ~ Ø6	0.00 ~ 0.02
Ø6.1 ~ Ø8	0.00 ~ 0.025
Ø8.1 ~ Ø20	0.00 ~ 0.03



(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)



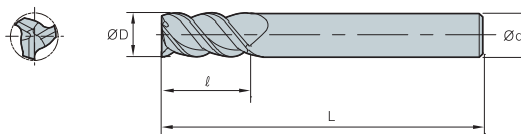
ØD	Tolerance
Ø1 ~ Ø6	0.00 ~ 0.02
Ø6.1 ~ Ø8	0.00 ~ 0.025
Ø8.1 ~ Ø20	0.00 ~ 0.03



(mm)

Designation		ØD	Ød	ℓ	L
APBE	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



AFE3000 (Short flat)

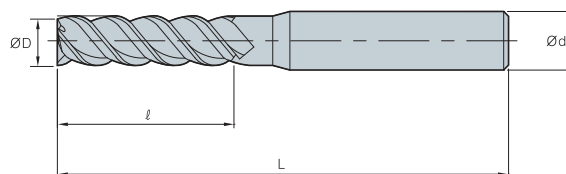
ØD	Tolerance
Ø1 ~ Ø12	0.00 ~ -0.02
Ø12.1 ~ Ø20	0.00 ~ -0.03



(mm)

Designation		ØD	Ød	ℓ	L
AFE 	3010-040-V2S6	1	6	2	40
	3010-040-V2.5S6	1	6	2.5	40
	3015-040-V3S6	1.5	6	3	40
	3020-040-V3S6	2	6	3	40
	3030-045-V4S6	3	6	4	45
	3030-045-V8S6	3	6	8	45
	3040-045-V5S6	4	6	5	45
	3040-045-V8S6	4	6	8	45
	3040-045-V11S6	4	6	11	45
	3050-045-V6S6	5	6	6	45
	3060-050-V7S6	6	6	7	50
	3060-050-V13S6	6	6	13	50
	3080-060-V9S8	8	8	9	60
	3080-060-V19S8	8	8	19	60
	3100-065-V11S10	10	10	11	65
	3100-065-V22S10	10	10	22	65
	3120-070-V13S12	12	12	13	70
	3120-070-V26S12	12	12	26	70
	3160-090-V18S16	16	16	18	90
	3160-090-V32S16	16	16	32	90
	3200-090-V22S20	20	20	22	90
	3200-090-V38S20	20	20	38	90

AFE3000 (Flat)



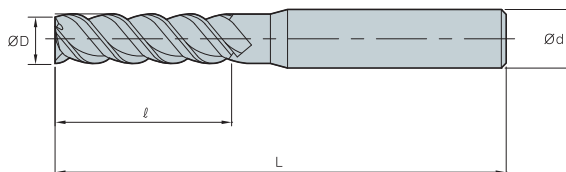
ØD	Tolerance
Ø1 ~ Ø12	0.00 ~ -0.02
Ø12.1 ~ Ø20	0.00 ~ -0.03



(mm)

Designation		ØD	Ød	ℓ	L
AFE 3	3010-050-V3S6	1	6	3	50
	3015-050-V5S6	1.5	6	5	50
	3020-050-V6S6	2	6	6	50
	3030-055-V11S6	3	6	11	55
	3040-055-V13S6	4	6	13	55
	3050-055-V17S6	5	6	17	55
	3060-060-V17S6	6	6	17	60
	3080-070-V22S8	8	8	22	70
	3100-075-V27S10	10	10	27	75
	3120-080-V32S12	12	12	32	80
	3160-100-V42S16	16	16	42	100
	3200-100-V48S20	20	20	48	100



AFE3000 (Long flat)

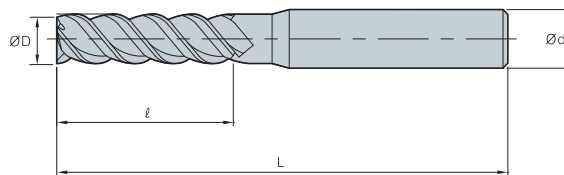
ØD	Tolerance
Ø1 ~ Ø12	0.00 ~ -0.02
Ø12.1 ~ Ø20	0.00 ~ -0.03



(mm)

Designation		ØD	Ød	ℓ	L
AFE 3	3010-060-V4S6	1	6	4	60
	3010-060-V6S6	1	6	6	60
	3015-060-V6S6	1.5	6	6	60
	3015-060-V8S6	1.5	6	8	60
	3015-060-V10S6	1.5	6	10	60
	3020-060-V8S6	2	6	8	60
	3020-060-V10S6	2	6	10	60
	3020-060-V12S6	2	6	12	60
	3030-065-V15S6	3	6	15	65
	3030-070-V20S6	3	6	20	70
	3030-075-V25S6	3	6	25	75
	3030-080-V30S6	3	6	30	80
	3040-065-V16S6	4	6	16	65
	3040-070-V20S6	4	6	20	70
	3040-075-V26S6	4	6	26	75
	3040-080-V30S6	4	6	30	80
	3060-060-V22S6	6	6	22	60
	3060-070-V25S6	6	6	25	70
	3060-075-V30S6	6	6	30	75
	3060-080-V35S6	6	6	35	80
	3060-090-V42S6	6	6	42	90
	3060-100-V50S6	6	6	50	100
	3080-080-V28S8	8	8	28	80
	3080-080-V30S8	8	8	30	80
	3080-085-V35S8	8	8	35	85
	3080-090-V40S8	8	8	40	90
	3080-095-V45S8	8	8	45	95
	3080-100-V50S8	8	8	50	100
	3080-105-V55S8	8	8	55	105
	3080-110-V65S8	8	8	65	110

AFE3000 (Long flat)



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

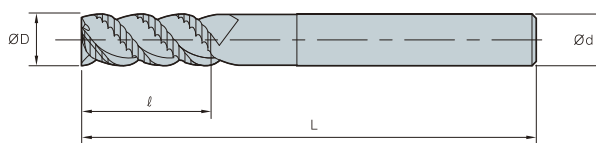


(mm)

Designation		ØD	Ød	ℓ	L
AFE 3	3100-090-V32S10	10	10	32	90
	3100-090-V35S10	10	10	35	90
	3100-090-V40S10	10	10	40	90
	3100-100-V45S10	10	10	45	100
	3100-100-V50S10	10	10	50	100
	3100-110-V55S10	10	10	55	110
	3100-110-V60S10	10	10	60	110
	3100-120-V65S10	10	10	65	120
	3120-095-V40S12	12	12	40	95
	3120-100-V45S12	12	12	45	100
	3120-100-V50S12	12	12	50	100
	3120-110-V55S12	12	12	55	110
	3120-110-V60S12	12	12	60	110
	3120-120-V65S12	12	12	65	120
	3120-120-V70S12	12	12	70	120
	3120-135-V75S12	12	12	75	135
	3160-105-V52S16	16	16	52	105
	3160-110-V55S16	16	16	55	110
	3160-130-V65S16	16	16	65	130
	3160-150-V75S16	16	16	75	150
	3160-160-V85S16	16	16	85	160
	3160-180-V95S16	16	16	95	180
	3160-190-V105S16	16	16	105	190
	3160-200-V115S16	16	16	115	200
	3200-110-V55S20	20	20	55	110
	3200-130-V65S20	20	20	65	130
	3200-150-V75S20	20	20	75	150
	3200-160-V85S20	20	20	85	160
	3200-180-V95S20	20	20	95	180
	3200-190-V105S20	20	20	105	190
	3200-200-V115S20	20	20	115	200
	3200-220-V125S20	20	20	125	220



APRE3000 (Roughing)



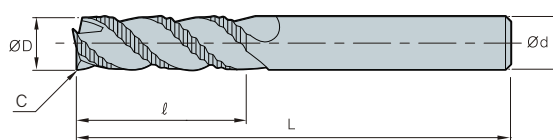
ØD	Tolerance
Ø4 ~ Ø8	0.00 ~ -0.07
Ø8.1 ~ Ø25	0.00 ~ -0.10



(mm)

Designation		ØD	Ød	ℓ	L
APRE	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

RPAE3000 (Wave roughing)



ØD	Tolerance
Ø6 ~ Ø10	0.000 ~ -0.058
Ø10 ~ Ø18	0.000 ~ -0.070
Ø18 ~ Ø25	0.000 ~ -0.084



(mm)

Designation		ØD	Ød	ℓ	L	L
RPAE	3060-063	6.0	6	18	63	0.3
	3070-063	7.0	8	23	63	0.3
	3080-063	8.0	8	23	63	0.3
	3090-080	9.0	10	30	80	0.3
	3100-080	10.0	10	30	80	0.3
	3110-080	11.0	12	32	80	0.5
	3120-080	12.0	12	32	80	0.5
	3140-080	14.0	14	32	80	0.5
	3160-105	16.0	16	48	105	0.5
	3180-105	18.0	18	48	105	0.5
	3200-105	20.0	20	50	105	0.5
	3250-105	25.0	25	50	105	0.5

F Technical Information for PCD Endmill

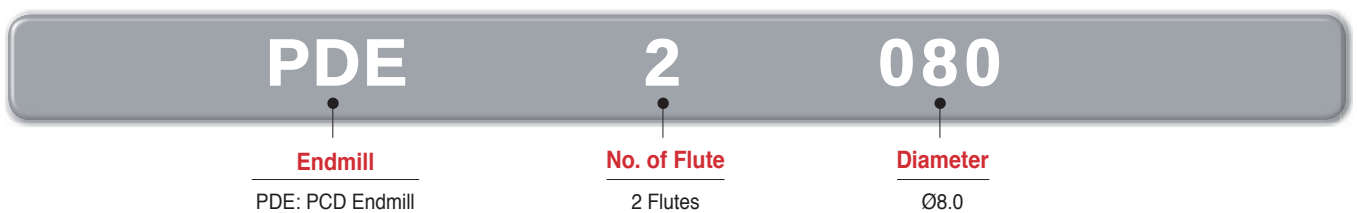
Longer tool life and good surface finishes

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 conditions

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

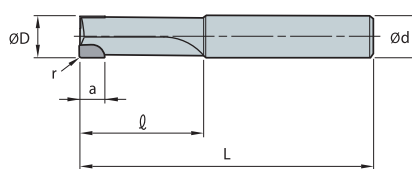


Fig.1

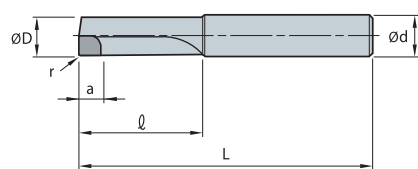
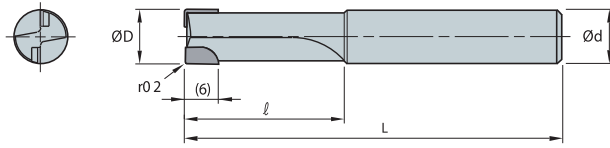


Fig.2

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

※ Depending on customer requests, we can make special Endmill



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

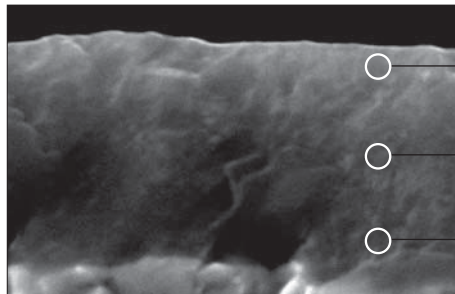
F Technical Information for Brazed Endmill

High precision machining with our high stiffness design

Brazed Endmills

- Applicable for high speed machining as it reduced frictional resistance while improving its wear resistance by implementing exclusive substrate and PVD coating
- 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

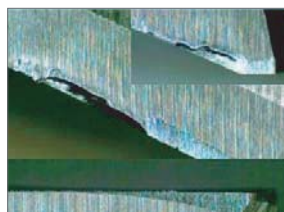
Brazed Endmills code system

Z	S	E	2	14	-	S
Brazed	Spiral	Endmill	No. of flutes	Diameter		Additional item classification
		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



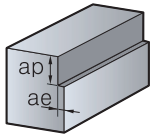
F

Endmills

Recommended cutting conditions (ZSE200 Flat)

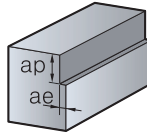
Workpiece Condition Diameter (Ø)	SM50C,SCM,GC (~HRC30)		STD61,STD11 (HRC30~45)		STD61 (HRC45~55)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
20	1,600	152	950	88	560	44
25	1,300	136	750	72	450	36
30	1,100	120	650	64	370	32
40	800	96	500	56	280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

Application tip



Side milling (under HRC45)

- $ap: \leq 1.5D$
- $ae: \leq 0.1D$



Side milling (over HRC45)

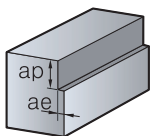
- $ap: \leq 1D$ (Max: 1 mm)

- * 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)

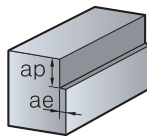
Workpiece Condition Diameter (Ø)	SM50C,SCM,GC (~HRC30)		STD61,STD11 (HRC30~45)		STD61 (HRC45~55)	
	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)	R.P.M n (min ⁻¹)	Feed vf (mm/min)
20	1,600	230	950	133	560	66
25	1,300	205	750	109	450	54
30	1,100	180	650	96	370	48
40	800	145	500	85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

Application tip



Side milling (under HRC45)

- $ap: \leq 1.5D$
- $ae: \leq 0.1D$

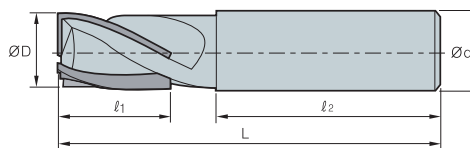
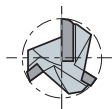


Side milling (over HRC45)

- $ap: \leq 1D$ (Max: 1 mm)

- * 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

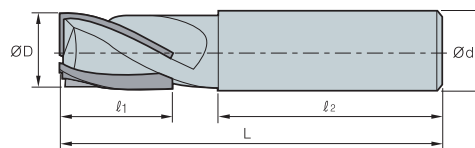
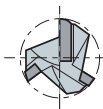
Special Endmills order: ZSE○○○○○-L

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

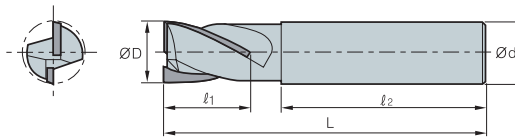
Designation		ØD	Ød	ℓ ₁	ℓ ₂	L
ZSE 3	332	32	32	45	90	150
	333	33	32	45	90	150
	334	34	32	50	85	150
	335	35	32	50	85	150
	338	38	32	55	80	150
	338S	38	42	55	80	150
	340	40	32	60	75	150
	340S	40	42	60	75	150
	342	42	32	60	75	150
	345	45	32	65	80	160
	345S	45	42	65	80	160
	350	50	32	65	80	160
	350S	50	42	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)



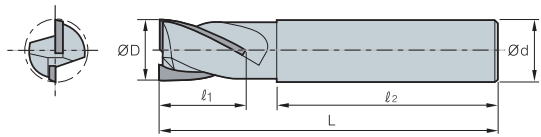
ØD	Tolerance
All	0.00~-0.05

(mm)

Designation		ØD	Ød	ℓ ₁	ℓ ₂	L
ZSEA 2	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)



2

4

H-A
24~26

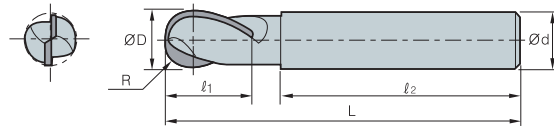
Carbide

Substrate
FCC
PC221F

ØD	Tolerance
All	0.00~-0.05

							(mm)
Designation		ØD	Ød	l ₁	l ₂	L	
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

(mm)

Designation	R	ØD	Ød	ℓ₁	ℓ₂	L
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

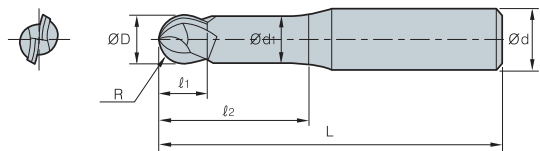
Ex.1) 2 flutes, diameter: 16.3, I: 28, L: 95 ZSEA2163 28-95L

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

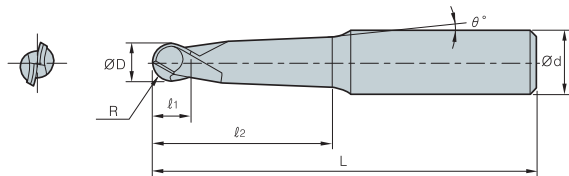
• ZSEL200/400, ZSEXL200

Special Endmills orde r: ZSEL200-I-L

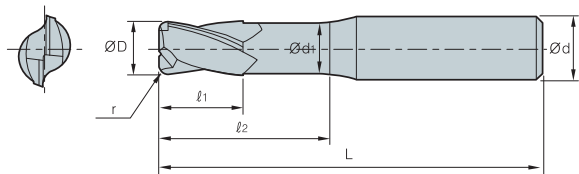




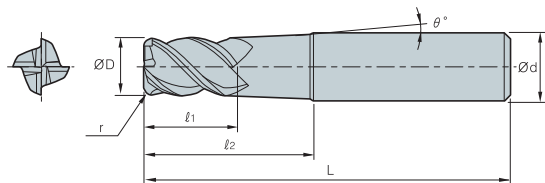
Designation	Flute	R	ØD	Ød	Ød ₁	l ₁	l ₂	L



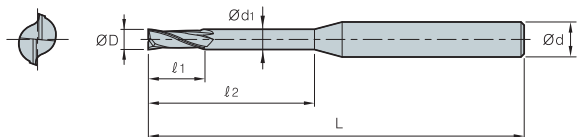
Designation	Flute	R	ØD	Ød	l ₁	l ₂	L	θ°



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