50th Anniversary Since 1966

KORLOY

F

ENDMILLS

Korloy Endmills, New technology and technical know-how, the best qualified for increasing productivity and machinability.

Technical Information for Endmills

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F04 KORLOY Endmills

Solid Endmills

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Special Endmill order Form

F100 Special Endmill Order Form

ENDMILLS

F Code System

I	B	E	2	040 -	050 -
1 Series	2 Type	3 Endmill	4 No. of Flutes	5 Cutting Dia.	6 Overall Length

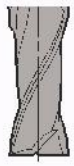
1 Series

I B E 2 040-050-R T-V N S

I, IP, Z	: Infinity-Max Endmill	SSEA, AP	: Aluminum Endmill
HP, P	: High performance-Max Endmill	IFSE, SP	: Stainless Endmill
C	: Copper-Max Endmill		
D	: Dia coated-Max Endmill		
V	: Variable Endmill		
FM	: Feed-up Endmill		

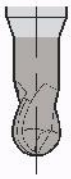
2 Type

I B E 2 040-050-R T-V N S



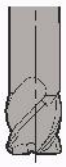
Flat type

F



Ball type

B



Radius type

R

3 Endmill

I B E 2 040-050-R T-V N S

4 No. of Flutes

I B E 2 040-050-R T-V N S

2 Flutes

2

3 Flutes

3

4 Flutes

4

6 Flutes

6

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

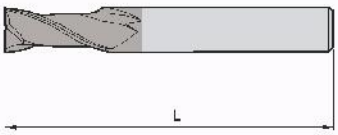
5 Cutting Dia

I 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

I B E 2 040-050-R T-V N S



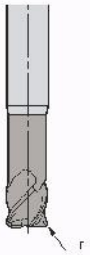
Overall Length	
Notation	L(mm)
050	50
080	80
100	100

R02 T00 - V05 N12 S06

7	8	9	10	11
Corner Radius	Taper Angle	Taper Length	Neck Length	Shank Diameter

7 Corner Radius

I 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

8 Taper Angle

I 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 Taper Length

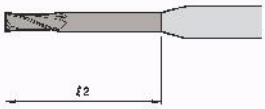
I B E 2 040-050-R T-**V** N S

Taper Length	
Notation	ℓ (mm)
V05	5
V10	10
V15	15

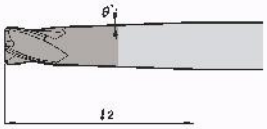
※ This code system is also for special endmills.

10 Neck Length

I B E 2 040-050-R T-V **N** S



Long Neck



Taper Long Neck

ℓ2(mm) : Neck Length

T(θ°) : Taper Angle

Long Neck	
Notation	ℓ2(mm)
N05	5
N08	8
N10	10
N12	12

Taper Long Neck	
Notation	ℓ2 + T(θ°)
N0510	5+1°
N0815	8+1.5°
N1020	10+2°
N1225	12+2.5°

11 Shank Diameter

I 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

Type	Shape	Designation	Substrate	Figure	Coated	Used	No. of flute	Size Min	Size Max	Workpiece P Steel	Workpiece M Stainless steel	Workpiece K Cast iron	Workpiece N Non-ferrous metal	Workpiece S Heat resistant alloy, Titanium alloy	Workpiece H Hardened steel	page
H-Max	Ball	HPBE2000	PC203F		○	High speed High hardness	2	0.6	16	◎		◎		○	◎	F11
		HPBE2000T	PC203F		○	High speed High hardness	2	1	12	◎		◎		○	◎	F11
	Radius	HPRE2000	PC203F		○	High speed High hardness	2	2	2	◎		◎		○	◎	F12
		HPRE4000	PC203F		○	High speed High hardness	4	3	16	◎		◎		○	◎	F12
		HPRE2000T	PC203F		○	High speed High hardness	2	2	2	◎		◎		○	◎	F12
		HPRE4000T	PC203F		○	High speed High hardness	4	2	16	◎		◎		○	◎	F12
New H Endmill	Ball	PBE2000	PC303S		○	High speed High hardness	2	0.5	12	○		◎		○	◎	F16
	Radius	PRE4000	PC310U		○	High speed High hardness	4	3	12	○		◎		○	◎	F17
V Endmill	Flat	VFE4000	PC215F		○	General	4	2.5	16	◎	○	○		○	○	F20
I-Max	Ball	IBE2000	PC220		○	General	2	1	20	◎	○	○	◎	○		F31
		IBE4000	PC220		○	General	2	3	20	◎	○	○	◎	○		F31
	Long Ball	IBE2000	PC220		○	General	2	3	20	◎	○	○	◎	○		F32
	Taper Ball	IBE2000-T	PC220		○	General	2	3	16	◎	○	○	◎	○		F32 F33
	Flat	IFE2000	PC220		○	General	2	1	20	◎	○	○	◎	○		F26
		IFE3000	PC220		○	General	3	2	16	◎	○	○	◎	○		F26
		IFE4000	PC220		○	General	4	2.5	20	◎	○	○	◎	○		F27
	Long Flat	IFE2000	PC220		○	General	2	3	20	◎	○	○	◎	○		F28
		IFE4000	PC220		○	General	4	3	20	◎	○	○	◎	○		F28
	Taper Flat	IFE2000-T	PC220		○	General	2	3	16	◎	○	○	◎	○		F29 F30
	Radius	IRE2000	PC220		○	General	2	3	20	◎	○	○	◎	○		F34
		IRE4000	PC220		○	General	4	3	20	◎	○	○	◎	○		F35

◎ : Excellent ○ : Good

Type	Shape	Designation	Substrate	Figure	Coated	Used	No. of flute	Size		Workpiece						page
										P	M	K	N	S	H	
								Min	Max	Steel	Stainless steel	Cast iron	Non-ferrous metal	Heat resistant alloy, Titanium alloy	Hardened steel	
I-Max	Ball	BE2000	FA2		–	Cast iron, Steel	2	1	20	○	○	○	◎			F41
		BE4000	FA2		–	Cast iron, Steel	4	3	20	○	○	○	◎			F41
	Long Ball	BE2000	FA2		–	Cast iron, Steel	2	3	20	○	○	○	◎			F42
	Taper Ball	BE2000-T	FA2		–	Cast iron, Steel	2	3	16	○	○	○	◎			F42 F43
	Flat	FE2000	FA2		–	Cast iron, Steel	2	1	16	○	○	○	◎			F36
		FE3000	FA2		–	Cast iron, Steel	3	2	16	○	○	○	◎			F36
	Flat	FE4000	FA2		–	Cast iron, Steel	4	2.5	20	○	○	○	◎			F37
	Long Flat	FE2000	FA2		–	Cast iron, Steel	2	3	20	○	○	○	◎			F38
		FE4000	FA2		–	Cast iron, Steel	4	3	20	○	○	○	◎			F38
	Taper Flat	FE2000-T	FA2		–	Cast iron, Steel	2	3	16	○	○	○	◎			F39 F40
Z Endmill New	Flat	ZFE2000	PC315E		○	General	2	1	16	◎	○	◎		○		F47
		ZFE4000	PC315E		○	General	4	1	16	◎	○	◎		○		F48
	Short Flat	ZSFE2000	PC315E		○	General	2	1	12	◎	○	◎		○		F49
		ZSFE4000	PC315E		○	General	4	1	12	◎	○	◎		○		F49
	Ball	ZBE2000	PC315E		○	General	2	1	12	◎	○	◎		○		F50
I+ Endmill New	Flat	IPFE2000	PC320		○	General	2	1	20	◎	○	◎		○		F54
		IPFE4000	PC320		○	General	4	1	20	◎	○	◎		○		F56
	Long Flat	IPLFE2000	PC320		○	General	2	1	20	◎	○	◎		○		F55
		IPLFE4000	PC320		○	General	4	1	20	◎	○	◎		○		F57
	Ball	IPBE2000	PC320		○	General	2	1	20	◎	○	◎		○		F58
		IPBE4000	PC320		○	General	4	1	20	◎	○	◎		○		F60

◎ : Excellent ○ : Good

Type	Shape	Designation	Substrate	Figure	Coated	Used	No. of flute	Size		Workpiece						page
								Min	Max	P Steel	M Stainless steel	K Cast iron	N Non-ferrous metal	S Heat resistant alloy, Titanium alloy	H Hardened steel	
I+ Endmill (New)	Long Ball	IPLBE2000	PC320		O	General	2	1	16	◎	O	◎		O		F59
	Radius	IPRE2000	PC320		O	General	2	1	12	◎	O	◎		O		F61 F62
		IPRE4000	PC320		O	General	4	2	12	◎	O	◎		O		F64
	Long Radius	IPLRE2000	PC320		O	General	2	3	12	◎	O	◎		O		F63
		IPLRE4000	PC320		O	General	4	3	12	◎	O	◎		O		F65
F Endmill	Standard	FME4000	PC203F		O	High speed	4	6	12	O		O		◎	◎	F68
	Long	FMLE4000	PC203F		O	High speed	4	6	12	O		O		◎	◎	F68
Micro Endmills	Flat	MSE2000	PC215F		O	High speed	2	0.2	1	O		O		◎	O	F70
	Ball	MSBE2000	PC215F		O	High speed	2	0.2	1	O		O		◎	O	F70
Solid Endmills for difficult to cut material	Flat	IFSE3000	PC210		–	STS	3	3	20	O	◎	O		◎		F73
S+ Endmill (New)	Flat	SPFE4000	PC325		–	STS	4	1	12	O	◎	O		◎		F76
	Long Flat	SPLFE4000	PC325		–	STS	4	1	12	O	◎	O		◎		F76
Solid Endmills for aluminum	Flat	SSEA2000	H01 PD3000		– (O)	Aluminum	2	1	20	O			◎			F78
		SSEA3000	H01 PD3000		– (O)	Aluminum	3	2	16	O			◎			F78
	Ball	SSBEA2000	H01 PD3000		– (O)	Aluminum	2	1	20	O			◎			F79
A+ Endmill (New)	Flat	APFE2000	H05S		–	Aluminum	2	2.5	20	O			◎			F82
		APFE3000	H05S		–	Aluminum	3	2.5	20	O			◎			F82
	Long Flat	APLFE2000	H05S		–	Aluminum	2	3	20	O			◎			F83
		APLFE3000	H05S		–	Aluminum	3	3	20	O			◎			F83
	Ball	APBE2000	H05S		–	Aluminum	2	1	12	O			◎			F84
	Roughing	APRE3000	H05S		–	Aluminum	3	4	25	O			◎			F84

◎ : Excellent ○ : Good

Type	Shape	Designation	Substrate	Figure	Coated	Used	No. of flute	Size		Workpiece						page
										P	M	K	N	S	H	
								Min	Max	Steel	Stainless steel	Cast iron	Nonferrous metal	Heat resistant alloy, Titanium alloy	Hardened steel	
C-Max	Flat	CFE2000	PC210C		○	Copper, Copper alloy	2	1.0	12	○			◎			F86
	Long Neck Flat	CFNE2000	PC210C		○	Copper, Copper alloy	2	0.5	4	○			◎			F86
	Ball	CBE2000	PC210C		○	Copper, Copper alloy	2	1.0	12	○			◎			F87
	Long Neck Ball	CBNE2000	PC210C		○	Copper, Copper alloy	2	0.5	4	○			◎			F87
	Radius	CRE2000	PC210C		○	Copper, Copper alloy	2	2.0	12	○			◎			F88
	Long Neck Radius	CRNE2000	PC210C		○	Copper, Copper alloy	2	1.0	4	○			◎			F88
D-Max	Ball	DBE2000	ND3000		○	Graphite, Aluminum	2	4	8				◎			F91
	Flat	DFE2000	ND3000		○	Graphite, Aluminum	2	3	8				◎			F91
	Radius	DRE2000	ND3000		○	Graphite, Aluminum	2	4	8				◎			F91
PCD Endmill	Flat	PDE1000	DP200		–	Nonferrous, High speed	1	4.6	6				◎			F93
		PDE2000	DP200		–	Nonferrous, High speed	2	6.0	12				◎			F93
Brazed Endmill	Flat	ZSE200	FCC PC221F		–	Cast iron, Steel	2	14	50	○	○	◎		○		F95
		ZSE300	FCC PC221F		–	Cast iron, Steel	3	14	50	○	○	◎		○		F95 F96
		ZSE400	FCC PC221F		–	Cast iron, Steel	4	14	50	○	○	◎		○		F96
		ZSE600	FCC PC221F		–	Cast iron, Steel	6	34	50	○	○	◎		○		F96
		ZSEA200	FCC		–	Aluminum, Copper	2	15	50				◎			F97
	Long Flat	ZSEL200	FCC PC221F		–	Cast iron, Steel	2	14	50	○	○	◎		○		F98
		ZSEL400	FCC PC221F		–	Cast iron, Steel	4	16	40	○	○	◎		○		F98
		ZSEXL200	FCC PC221F		–	Cast iron, Steel	2	20	25	○	○	◎		○		F98
	Ball	ZSBE200	FCC PC221F		–	Cast iron, Steel	2	13	50	○	○	◎		○		F99

◎ : Excellent ○ : Good

New PVD coating technology for anti-corrosion and wear resistance

H-Max

- H-max can be used for pre-hardened steel and heat-treated steel
- H-max guarantees highly accurate machining (diameter and radius)
- New PVD coating technology improves anti-corrosion and wear resistance

HPBE

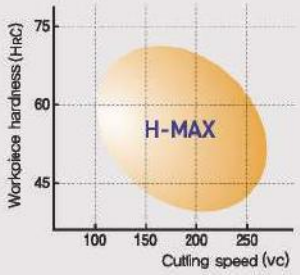
HPRE

- **Tolerance**
  Diameter : 0~-0.015 Radius : 0~-0.005

▶ Ultra fine grade for tougher edge and less chipping

▶ Combination of the new PVD coating and the hardened anti corrosion substrate guarantees excellent performance

Application area (Ball. Radius type)



- Cutting speed vc(m/min)
  ※ by diameter

Test examples

■ **Joint mold core machining (STD11 HRC54~59)**

- Workpiece : STD11 HRC54~59
- Cutting condition : vc =170(m/min), v^f=800(mm/min)
  ap =0.2 ae=0.5, oil mist
- Tool : HPBE2080 PC203F
- Result : 130min cutting time (Roughing), long tool life, wear resistance, no chipping found

Test Result

	Point	Edge	Edge
H - Max			
Competitor			

Tool life 125% up

Recommended Cutting Condition (HPBE)

Workpiece / Condition / Diameter(Ø)	NAK80, STD61 (~ HRC 50)			STD11, STS420 (HRC 50~60)			SKH (HRC 60~65)		
	R.P.M n(min⁻¹)	Feed vf(mm/min)	Axial depth ap(mm)	R.P.M n(min⁻¹)	Feed vf(mm/min)	Axial depth ap(mm)	R.P.M n(min⁻¹)	Feed vf(mm/min)	Axial depth ap(mm)
1	40,000	4,800	0.06	40,000	3,360	0.05	40,000	3,160	0.04
2	40,000	5,760	0.11	40,000	4,800	0.10	24,000	2,280	0.07
3	40,000	7,200	0.13	32,000	4,620	0.12	16,000	1,020	0.09
4	32,000	6,528	0.15	24,000	1,920	0.13	12,000	1,440	0.10
6	21,000	5,040	0.20	10,000	2,000	0.20	8,000	1,020	0.11
8	16,000	3,840	0.30	12,000	2,160	0.20	6,000	840	0.11
10	13,000	3,120	0.50	10,000	1,920	0.20	4,800	660	0.12
12	9,000	2,160	0.50	7,000	1,320	0.30	3,600	516	0.12
16	6,000	1,440	0.50	5,000	960	0.30	2,500	390	0.15

Recommended Cutting Condition (HPRE)

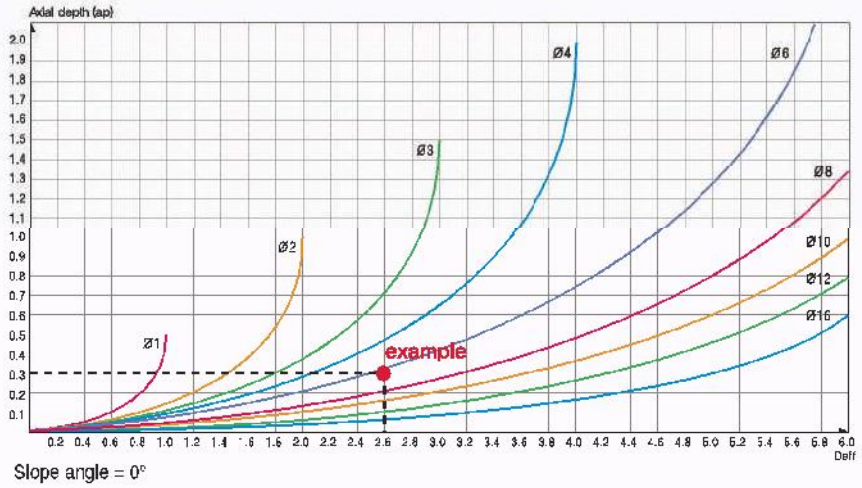
Workpiece / Condition / Diameter(Ø)	NAK80, STD61 (~ HRC 50)			STD11, STS420 (HRC 50~60)			SKH (HRC 60~65)		
	R.P.M n(min⁻¹)	Feed vf(mm/min)	Axial depth ap(mm)	R.P.M n(min⁻¹)	Feed vf(mm/min)	Axial depth ap(mm)	R.P.M n(min⁻¹)	Feed vf(mm/min)	Axial depth ap(mm)
1	40,000	720	0.10	40,000	480	0.03	32,000	300	0.02
2	40,000	1,200	0.10	24,000	600	0.05	16,000	380	0.05
3	32,000	2,280	0.20	16,000	1,140	0.10	11,000	720	0.05
4	24,000	2,640	0.30	12,000	1,320	0.10	8,000	480	0.05
6	16,000	3,480	0.40	8,000	1,740	0.20	5,300	1,080	0.10
8	12,000	3,480	0.50	6,000	1,740	0.20	4,000	1,080	0.10
10	9,600	3,480	0.60	4,800	1,740	0.30	3,200	1,080	0.20
12	8,000	2,880	0.80	4,000	1,440	0.30	2,700	900	0.20
16	6,000	2,160	1.00	3,000	1,080	0.50	2,000	680	0.30
20	4,800	1,740	1.00	2,400	840	0.50	1,600	528	0.30

Cutting speed formulas (Ball Endmills)

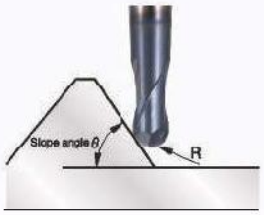
- Efficient cutting speed Veff = π × Deff × n/1000 (n=min⁻¹)
- Efficient diameter Deff calculation formula : Deff=($2\sqrt{ap(D-ap)}$ × α)
  D–Ø(Tool diameter), Deff–Efficient diameter
- Efficient cutting speed formulas : When slope O is 0° Veff = π × Deff × n/1000
  Deff = Efficient, diameter Calculate Deff as ap with various ball endmills

α :
- α = 1 Slope angle θ = 0°
- α = 1.2 Slope angle θ = 7°
- α = 1.5 Slope angle θ = 15°
- α = 1.7 Slope angle θ = 30°
- α = 2.17 Slope angle θ = 45°
- α = 2.3 Slope angle θ = 60°

Cutting speed formulas (Ball Endmills, Slope angle = 0°)



Slope angle = 0°



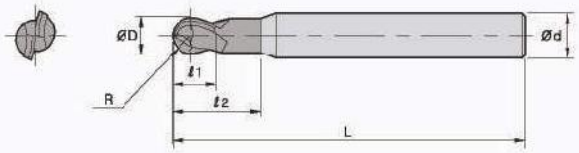
Ex) Diameter : 6mm, ap=0.3mm,
Deff=2.6mm, N=14,000(min⁻¹)
Slope angle 0° : Veff = 113.7(m/min)
Slope angle 15° :
Veff = 113.7 x 1.5 = 170.6(m/min)

Veff (efficient cutting speed) technical data as per depth and workpiece hardness (H-max, Ball Endmills)

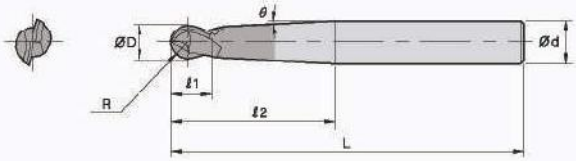
Dimensions		HRC45~55	vc	Efficient cutting speed by depth (z-step=ap)														
Tool diameter	Ball R	RPM		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5
0.6	0.3	40,000	75	56	71	75	71	56										
0.8	0.4	37,000	93	61	80	90	93	90	80	61								
1	0.5	35,000	110	66	88	101	108	110	108	101	88	66						
1.5	0.75	32,000	151	75	102	121	133	142	148	150	150	148	142	133	121	102	75	0
2	1	30,000	188	82	113	135	151	163	173	180	185	187	188	187	285	180	173	163
2.5	1.25	28,000	220	86	119	143	161	176	188	197	205	211	215	218	220	220	218	215
3	1.5	26,000	245	88	122	147	167	183	196	207	217	224	231	236	240	243	244	245
4	2	22,000	276	86	120	146	166	183	197	210	221	231	239	247	253	259	264	268
5	2.5	20,000	314	88	123	149	170	188	204	218	230	241	251	260	268	275	282	288
6	3	18,000	339	87	122	148	169	187	203	218	231	242	253	262	271	279	287	294
7	3.5	15,000	330	78	110	134	153	170	185	198	210	221	231	240	249	256	264	271
8	4	13,500	339	75	106	129	148	164	179	192	203	214	224	234	242	250	258	265
9	4.5	12,000	339	71	100	122	140	155	169	182	193	203	213	222	231	238	246	253
10	5	11,000	345	69	97	118	135	151	164	176	187	198	207	216	224	232	240	247
11	5.5	10,000	345	66	92	113	129	144	157	169	179	189	199	207	215	223	230	237
12	6	9,200	347	63	89	108	124	139	151	162	173	183	192	200	208	215	223	229
13	6.5	8,500	347	61	85	104	120	133	146	157	167	176	185	193	201	208	215	222
14	7	7,900	347	58	82	101	116	129	141	151	161	170	179	187	194	202	208	215
15	7.5	7,400	349	57	80	98	112	125	137	147	157	166	174	182	189	196	203	209
16	8	6,900	347	55	77	94	108	121	132	142	151	160	168	175	183	189	196	202
17	8.5	6,500	347	53	75	91	105	117	128	138	147	155	163	171	178	184	191	197
18	9	6,100	345	51	72	88	102	113	124	133	142	150	158	165	172	178	185	191
19	9.5	5,800	346	50	71	86	99	111	121	130	139	147	155	162	168	175	181	187
20	10	5,500	345	49	69	84	97	108	118	127	135	143	151	157	164	170	176	182

Dimensions		HRC45~55	vc	Efficient cutting speed by depth (z-step=ap)														
Tool diameter	Ball R	RPM		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5
0.6	0.3	40,000	75	56	71	75	71	56										
0.8	0.4	37,000	93	61	80	90	93	90	80	61								
1	0.5	35,000	110	66	88	101	108	110	108	101	88	66						
1.5	0.75	28,000	132	66	90	106	117	124	129	132	132	129	124	117	106	90	66	
2	1	26,000	163	71	98	117	131	141	150	156	160	162	163	162	160	156	150	141
2.5	1.25	24,000	188	74	102	122	138	151	161	169	176	181	185	187	188	188	187	185
3	1.5	22,000	207	74	103	124	141	154	166	175	183	190	195	200	203	205	207	207
4	2	18,500	232	73	101	122	139	154	166	177	186	194	201	206	213	218	222	225
5	2.5	16,500	259	73	102	123	141	155	168	180	190	199	207	215	221	227	233	237
6	3	15,000	283	72	101	123	141	156	170	181	192	202	211	219	226	233	239	245
7	3.5	15,000	330	78	110	134	153	170	185	198	210	221	231	240	249	256	264	271
8	4	12,000	301	67	94	115	131	146	159	170	181	190	199	208	215	222	229	235
9	4.5	10,650	301	63	89	108	124	138	150	161	171	181	189	197	205	212	218	224
10	5	9,600	301	30	84	103	118	131	143	154	164	173	181	189	196	203	209	215
11	5.5	8,700	300	57	80	98	113	125	136	147	156	165	173	180	187	194	200	206
12	6	8,000	301	55	77	94	108	120	131	141	150	159	167	174	181	187	194	199
13	6.5	7,373	301	53	74	90	104	116	126	136	145	153	160	168	174	181	187	192
14	7	6,800	299	50	71	87	110	111	121	130	139	147	154	161	167	174	179	185
15	7.5	6,300	297	48	68	83	96	107	116	125	133	141	148	155	161	167	173	178
16	8	5,900	296	47	66	80	93	103	113	121	129	137	144	150	156	162	168	173
17	8.5	5,600	299	46	64	79	91	101	110	119	127	134	141	147	153	159	164	170
18	9	5,300	300	45	63	77	88	98	108	116	123	131	137	144	149	155	160	166
19	9.5	5,000	298	43	61	74	86	95	104	112	120	127	133	139	145	151	156	161
20	10	4,700	295	42	59	72	83	92	101	108	116	122	129	135	140	146	151	155

HPBE2000 (Ball) / 2000L (Long Ball)



HPBE2000T (Taper Ball)



H·A 30°

TIAlN

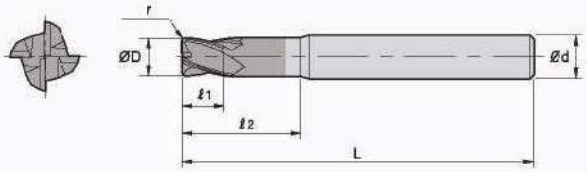
Substrate PC203F

ØD	Tolerance	R Tolerance
Ø0.6~Ø6	0 ~ - 0.02	±0.005
Ø7~Ø16	0 ~ - 0.025	±0.010

(mm)

	Designation	R	ØD	Ød	ℓ1	ℓ2	L	θ°
HPBE	2006	0.3	0.6	6	1.2	4	50	
	2008	0.4	0.8	6	1.6	4	50	
	2010	0.5	1	6	2	4	50	
	2020	1	2	6	3	6	50	
	2030	1.5	3	6	4	8	50	
	2040	2	4	6	5	10	60	
	2050	2.5	5	6	6	12	60	
	2060	3	6	6	7	14	60	
	2070	3.5	7	8	8	16	80	
	2080	4	8	8	9	18	80	
	2090	4.5	9	10	10	20	80	
	2100	5	10	10	11	22	80	
	2110	5.5	11	12	12	24	90	
	2120	6	12	12	13	26	90	
	2140	7	14	16	15	30	100	
	2160	8	16	16	17	34	100	
HPBE	2060L	3	6	6	7	14	90	
	2070L	3.5	7	8	8	16	90	
	2080L	4	8	8	9	18	100	
	2090L	4.5	9	10	10	20	100	
	2100L	5	10	10	11	22	100	
HPBE	2010-T2-26	0.5	1	6	2	26	55	1
	2010-T4-16	0.5	1	6	2	16	50	2
	2020-T2-41	1	2	6	3	41	70	1
	2020-T4-29	1	2	6	3	29	60	2
	2030-T2-51	1.5	3	6	4	51	80	1
	2030-T4-29	1.5	3	6	4	29	60	2
	2040-T2-61	2	4	6	5	61	90	1
	2040-T4-34	2	4	6	5	34	70	2
	2060-T2-63	3	6	6	7	63	90	1
	2060-T4-35	3	6	6	7	35	90	2
	2080-T2-67	4	8	8	11	67	100	1
	2080-T4-39	4	8	8	11	39	100	2
	2100-T2-69	5	10	10	13	69	120	1
	2100-T4-41	5	10	10	13	41	120	2
	2120-T2-71	6	12	12	15	71	130	1
	2120-T4-43	6	12	12	15	43	130	2

HPRE2000 / 4000 (Radius)

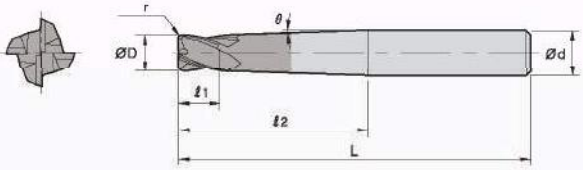


ØD	Tolerance	R Tolerance
Ø0.6~Ø6	0 ~ -0.02	±0.005
Ø7~Ø16	0 ~ -0.025	±0.010

(mm)

	Designation	ØD	Ød	ℓ1	ℓ2	L	r
HPBE	2020-R0.5	2	6	3	12	60	0.5
HPRE	4030-R0.5	3	6	4	16	60	0.5
	4040-R0.5	4	6	5	20	60	0.5
	4060-R1.0	6	6	7	28	60	1
	4080-R2.0	8	8	9	31	80	2
	4100-R2.0	10	10	11	33	90	2
	4120-R2.0	12	12	13	39	100	2
	4160-R2.0	16	16	17	51	120	2

HPRE2000T / 4000T (Taper Radius)



ØD	Tolerance	R Tolerance
Ø0.6~Ø6	0 ~ -0.02	±0.005
Ø7~Ø16	0 ~ -0.025	±0.010

(mm)

	Designation	ØD	Ød	ℓ1	ℓ2	L	r	θ°
HPRE	2020-R0.5-T4-13	2	6	3	13	70	0.5	2
	2020-R0.5-T2-18	2	6	3	18	70	0.5	1
HPRE	4020-R0.5-T2-23	2	6	3	23	70	0.5	1
	4020-R0.5-T4-18	2	6	3	18	70	0.5	2
	4030-R0.5-T2-24	3	6	4	24	90	0.5	1
	4030-R0.5-T4-19	3	6	4	19	90	0.5	2
	4040-R0.5-T2-61	4	8	5	61	100	0.5	1
	4040-R0.5-T4-34	4	8	5	34	70	0.5	2
	4060-R1.0-T2-63	6	10	7	63	100	1	1
	4060-R1.0-T4-36	6	10	7	35	70	1	2
	4080-R2.0-T2-65	8	12	9	65	110	2	1
	4080-R2.0-T4-37	8	12	9	37	90	2	2
	4100-R2.0-T2-69	10	14	11	69	110	2	1
	4100-R2.0-T4-40	10	14	11	40	100	2	2
	4120-R2.0-T2-71	12	16	13	71	110	2	1
	4120-R2.0-T4-42	12	16	13	42	110	2	2
	4160-R2.0-T2-73	16	20	17	73	130	2	1
	4160-R2.0-T4-45	16	20	17	45	130	2	2

Endmill series for high speed machining for high hardened steel

H Endmill

- 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

before

After special edge treatment

Improved stability

- **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 Series (Ball)

Cutting load is dispersed

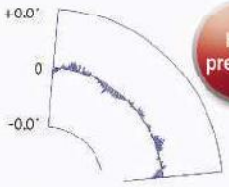
S shape of ball

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

PRE Series (Radius)

H Endmill radius

New shape of corner R



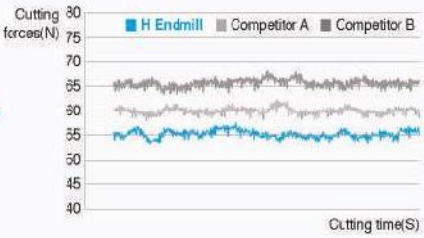
High precision

Measurement result of tolerance of corner R

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

- **Workpiece** D2(AISI) / X100CrMoV5 1(DIN) / SKD11(JIS), HRC60
- **Cutting conditions** Diameter=Ø8.0, 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.**

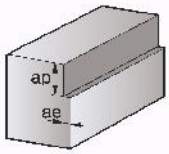


Reduced cutting loads

Recommended cutting conditions(PRE4000 Radius)

Workpiece / Conditions / Diameter(Ø)	Pre hardened steel (HRC35~45)		Hardened steel (HRC45~55)		High hardened steel (HRC55~70)	
	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)
3	17,300	1,250	11,500	840	7,500	256
4	13,200	1,300	8,800	880	5,600	268
5	12,500	1,500	8,300	1,000	5,100	296
6	10,350	1,400	6,900	950	4,200	280
8	7,800	1,350	5,200	900	3,200	264
10	6,150	1,260	4,100	840	2,550	248
12	5,250	1,260	3,500	840	2,100	240

● Application tip

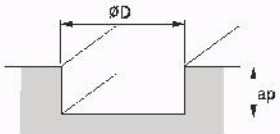


- Shouldering depth(ap) and radial depth(ae)
  - ap = 0.1D
  - ae = 0.03D
  - Workpiece should be clamped rigidly. In case of vibration, reduce R.P.M and feed rate by the same ratio

Recommended cutting conditions(PRE4000 Radius)

Workpiece / Conditions / Diameter(Ø)	Pre hardened steel (HRC35~45)		Hardened steel (HRC45~55)		High hardened steel (HRC55~70)	
	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)
3	17,300	544	11,500	336	7,500	128
4	13,200	560	8,800	352	5,600	136
5	12,500	644	8,300	400	5,100	144
6	10,350	616	6,900	384	4,200	144
8	7,800	576	5,200	356	3,200	132
10	6,150	544	4,100	332	2,550	124
12	5,250	544	3,500	332	2,100	124

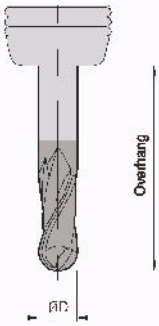
● Application tip



- Slotting depth(ap)
  - ap = 0.05D
  - ae = 1.0D
  - Workpiece should be clamped rigidly. In case of vibration, reduce R.P.M and feed rate by the same ratio

Cutting condition by overhang

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



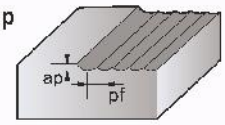
Notice

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

Recommended cutting conditions (PBE2000 Ball)

Workpiece / Conditions / Diameter(Ø)	Pre hardened steel (HRC35~45)		Hardened steel (HRC45~55)		High hardened Steel (HRC55~HRC70)	
	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)
0.5	35,000	1,470	31,500	1,330	28,000	1,050
1	35,000	2,940	31,500	2,660	28,000	2,000
1.2	33,600	3,010	30,100	2,695	26,600	2,100
1.5	33,600	3,150	30,100	2,800	25,900	2,150
2	33,460	3,360	28,000	2,800	24,500	2,200
2.5	25,900	3,710	22,400	2,800	17,500	2,200
3	22,260	3,710	18,550	2,800	16,500	2,200
4	16,730	3,710	14,000	2,800	13,000	2,200
5	17,800	4,900	15,000	3,750	12,500	2,100
6	13,400	4,100	11,000	3,100	10,000	2,500
8	10,700	3,500	9,000	2,700	8,000	2,150
10	8,900	3,100	7,500	2,400	6,600	1,900
12	6,680	2,500	5,600	1,900	5,000	1,550

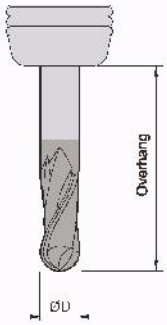
● **Application tip**



- ap = 0.02D
- pf = 0.05D
- Workpiece should be clamped rigidly. In case of vibration, reduce RPM and feed rate by the same ratio

Cutting condition by overhang

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



Notice

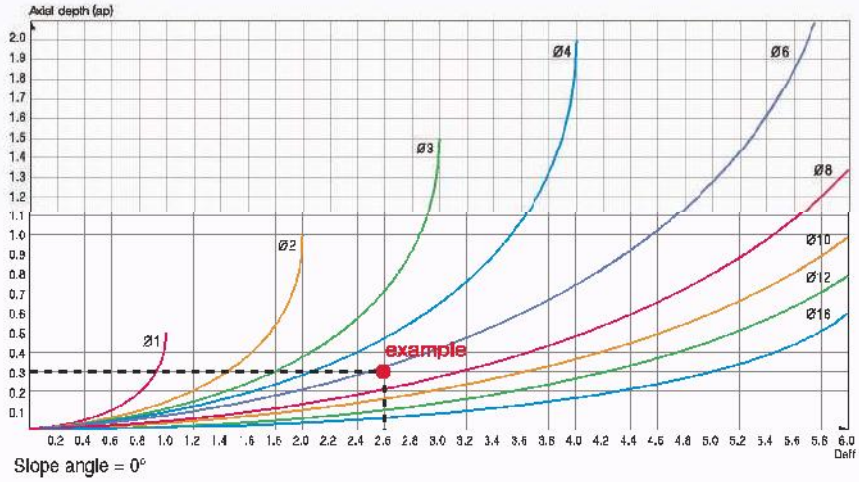
- Cutting conditions are up to the machine's condition and the shape of cutting.
- Use cutting fluid that is proper to the workpiece and produces few temperature reaction.

Cutting speed formulas (Ball Endmills)

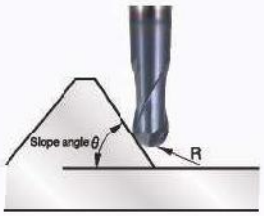
- Efficient cutting speed Veff = (π × Deff × n)/1000 (n = min⁻¹)
- Efficient diameter Deff calculation formula Deff = ($2\sqrt{ap(D-ap)} \times \alpha$)
  D=Ø(Tool diameter), Deff=Efficient diameter
- Efficient cutting speed formulas : When slope Ø is 0° Veff = (π × Deff × n) /1000
  Deff = Efficient, diameter Calculate Deff as ap with various ball endmills

α :		
	α = 1	Slope angle θ = 0°
	α = 1.2	Slope angle θ = 7°
	α = 1.5	Slope angle θ = 15°
	α = 1.7	Slope angle θ = 30°
	α = 2.17	Slope angle θ = 45°
	α = 2.3	Slope angle θ = 60°

Cutting speed formulas (Ball Endmills, Slope angle = 0°)

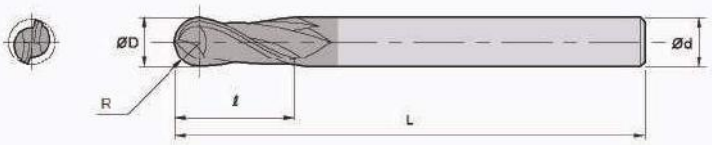


Slope angle = 0°



Ex) **Diameter** : 6mm, ap=0.3mm,
Deff=2.6mm, N=14,000(min⁻¹)
Slope angle 0° : Veff = 113.7(m/min)
Slope angle 15° :
Veff = 113.7 x 1.5 = 170.6(m/min)

PBE2000 (Ball)

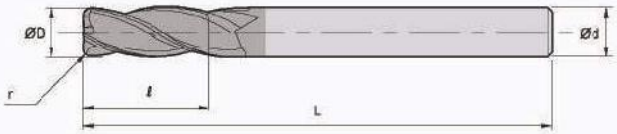


ØD	Tolerance
~ Ø5.9	0.00 ~ -0.015
Ø6.0 ~	0.00 ~ -0.025

(mm)

	Designation	R	ØD	Ød	ℓ	L
PBE	PBE2005-040	0.25	0.5	6	1	40
2	PBE2010-050	0.5	1	6	2.5	50
	PBE2012-050	0.6	1.2	6	3	50
	PBE2015-050	0.75	1.5	6	4	50
	PBE2020-050	1	2	6	5	50
	PBE2025-060	1.25	2.5	6	7	60
	PBE2030-060	1.5	3	6	8	60
	PBE2040-070	2	4	6	8	70
	PBE2050-080	2.5	5	6	10	80
	PBE2060-090	3	6	6	12	90
	PBE2080-100	4	8	8	14	100
	PBE2100-100	5	10	10	18	100
	PBE2120-110	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	PRE4030-060-R01	3	6	8	60	0.1
	PRE4030-060-R02	3	6	8	60	0.2
	PRE4030-060-R03	3	6	8	60	0.3
	PRE4030-060-R05	3	6	8	60	0.5
	PRE4040-070-R01	4	6	10	70	0.1
	PRE4040-070-R02	4	6	10	70	0.2
	PRE4040-070-R03	4	6	10	70	0.3
	PRE4040-070-R05	4	6	10	70	0.5
	PRE4040-070-R10	4	6	10	70	1
	PRE4060-090-R02	6	6	15	90	0.2
	PRE4060-090-R03	6	6	15	90	0.3
	PRE4060-090-R05	6	6	15	90	0.5
	PRE4060-090-R10	6	6	15	90	1
	PRE4080-100-R02	8	8	20	100	0.2
	PRE4080-100-R03	8	8	20	100	0.3
	PRE4080-100-R05	8	8	20	100	0.5
	PRE4080-100-R10	8	8	20	100	1
	PRE4100-100-R03	10	10	25	100	0.3
	PRE4100-100-R05	10	10	25	100	0.5
	PRE4100-100-R10	10	10	25	100	1
	PRE4120-110-R03	12	12	30	110	0.3
	PRE4120-110-R05	12	12	30	110	0.5
	PRE4120-110-R10	12	12	30	110	1

Improved productivity with effective machining due to less vibration

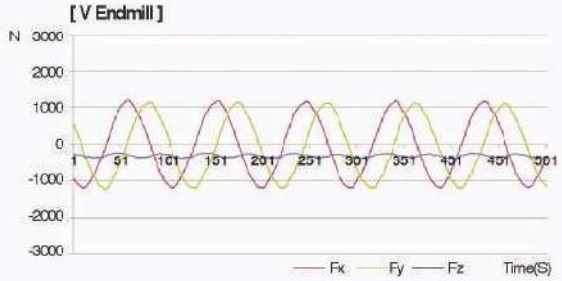
V Endmill

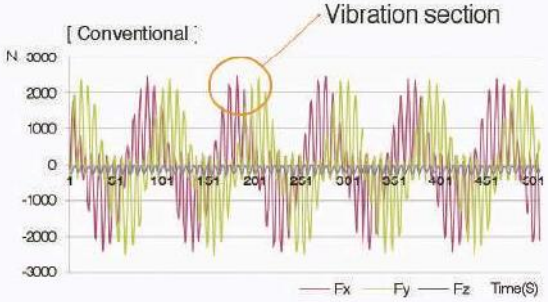
Variable Endmill

- Irregular helix angle
- Irregular indexing angle

※ Irregular flute spacing : Decreased vibration

Performance(Vibration test)





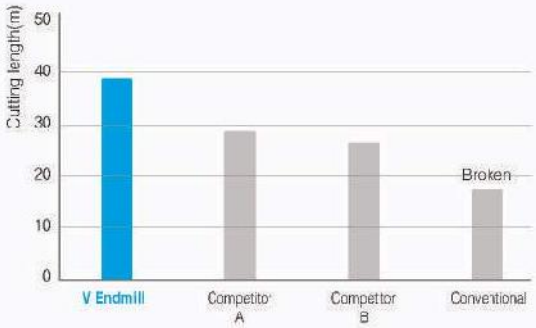
- **Workpiece** Alloy steel
- **Cutting condition** D=Ø8.0, n(min⁻¹)=3183, vc(m/min)=80, vf(mm/min)=713, fz(mm/t)=0.055, ap(mm)=8.0, ae(mm)=8.0, Dry
- **Tools** V Endmill VFE4080-060 · Conventional endmill

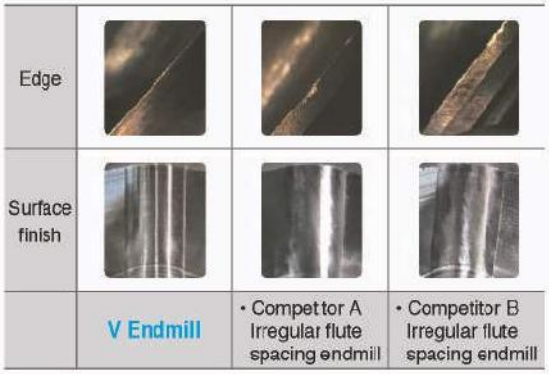
■ **Advantage of V Endmill**

Type	Cutting speed(vc)	Feed(vf)	Vibration	Quality
V Endmill	30% up	30% up	Minimize	Excellent

· Higher cutting speed and feed rate increase productivity.
· Less vibration realizes excellent surface finish and higher quality machining.

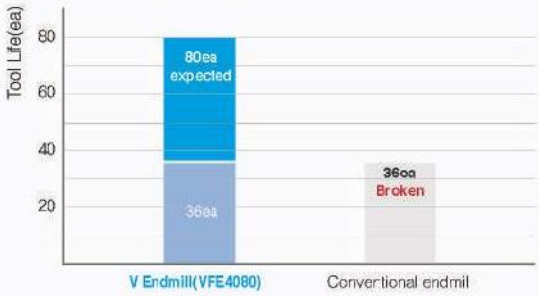
Performance(Surface finish)





- **Workpiece** Stainless steel
- **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)=0.5, Dry
- **Tools** VFE4080-060

Machining example



V Endmill　　범용 엔드밀

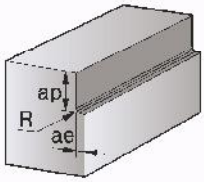
- **Workpiece** Alloy steel
- **Cutting condition** D=Ø8.0, n(m/min)=6000, vc(m/min)=150, vf(mm/min)=600, fz(mm/t)=0.025, ap(mm)=7, ae(mm)=0.8, Wet(Water-soluble)
- **Tools** VFE4080-060

Cutting condition

■ Shouldering

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

● Application tip



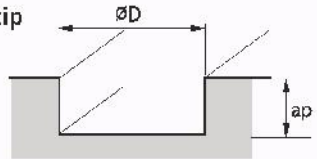
※ Cutting condition by overhang

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

■ Slotting

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

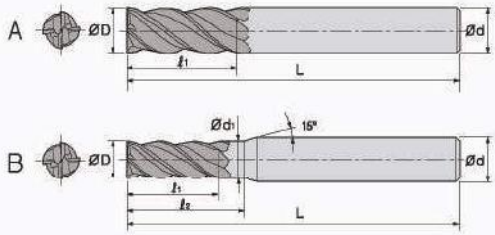
● Application tip



※ Cutting condition by overhang

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

VFE4000 (Flat)



ØD	Tolerance
Ø3~Ø9	0.00 ~ -0.02
Ø10~Ø16	0.00 ~ -0.03

(mm)

Designation		ØD	Ød	d1	ℓ1	ℓ2	L	Type
VFE	4025-045	2.5	6.0	2.48	6.0	8.0	45	B
	4030-050	3.0	6.0	2.96	7.0	9.5	50	B
	4035-050	3.5	6.0	3.46	8.0	11.0	50	B
	4040-050	4.0	6.0	3.96	9.0	12.0	50	B
	4050-050	5.0	6.0	4.96	12.0	16.0	50	B
	4060-050	6.0	6.0	-	14.0	-	50	A
	4070-060	7.0	8.0	6.97	16.0	21.0	60	B
	4080-060	8.0	8.0	-	19.0	-	60	A
	4090-070	9.0	10.0	8.97	20.0	27.0	70	B
	4100-075	10.0	10.0	-	23.0	-	75	A
	4120-080	12.0	12.0	-	27.0	-	80	A
	4140-085	14.0	14.0	-	31.0	-	85	A
	4160-090	16.0	16.0	-	36.0	-	90	A

I-Max is ideal for all kinds of milling operations due to the variety of available choices

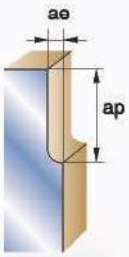
I-Max

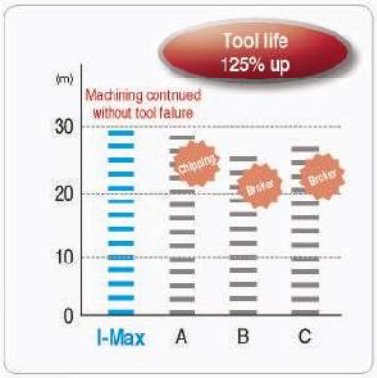
- Excellent wear resistance and anti chipping due to super ultra fine grain substrate and PVD coating
- Wide application from roughing to finishing
- Various workpieces can be machined (steel, alloy steel, cast iron, stainless steel, and aluminum)
- Long tool life under 150m/min(vc), CNC milling machine
- I-Max is ideal for various kinds of milling operations due to the variety of choices
- Multi-purpose machining (shouldering, grooving, ramping, etc.)

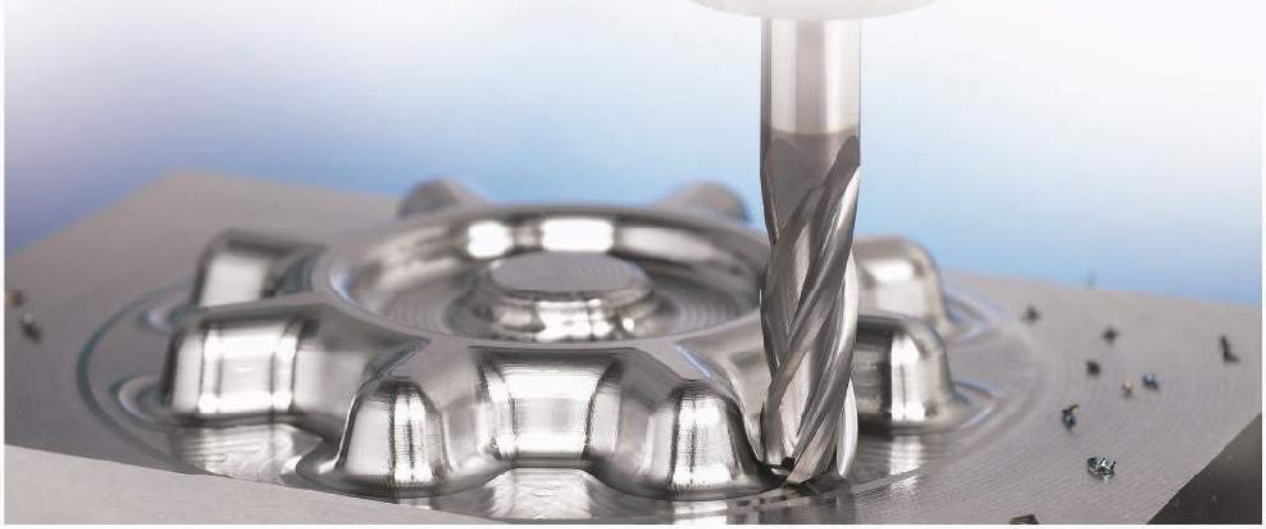
Comparison

- **Workpiece** : NAK80(HRC40) Hexahedron, Climb milling-Air
- **Cutting condition** : vc=70m/min, fz=0.04mm/t, n= 3,700min^{-1}, vf=590m/min, ap=10mm, ae=1.0mm
- **Tool** : IFE4060-050

I - Max	Competitor A	Competitor B	Competitor C
30m machining Edge is good	30m machining Chipping	24m machining Broken	28m machining Broken



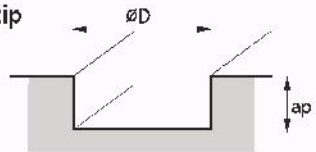




Recommended Cutting Condition (IFE2000, Slotting)

Workpiece / Condition / Diameter(Ø)	Steel, Alloy steel (~ HRC20)		Steel, Alloy steel (HRC30~40)		Steel, Alloy steel (HRC40~)		Cast iron Graphite cast iron		Stainless steel Titanium alloy	
	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)
1	37,500	185	25,400	130	19,500	80	39,700	370	16,000	45
2	18,800	190	12,700	180	9,700	80	19,800	450	8,000	65
3	12,600	310	8,200	190	6,400	80	12,900	450	5,300	65
4	9,500	310	6,400	190	4,800	80	9,800	450	4,000	65
5	7,500	310	5,400	190	3,900	80	7,600	450	3,200	65
6	6,500	310	4,100	190	3,000	80	7,800	660	2,600	65
8	4,800	310	3,200	190	2,500	80	6,000	710	2,000	65
10	3,700	310	2,600	190	1,900	80	4,800	740	1,600	65
12	3,100	310	2,100	190	1,600	80	3,700	780	1,300	65
14	2,700	310	1,800	190	1,400	80	3,400	820	1,100	65
16	2,400	340	1,500	240	1,200	90	3,000	830	1,000	75
18	2,000	340	1,400	240	1,000	100	2,600	890	880	80
20	1,900	340	1,300	240	900	100	2,400	890	800	80

Application tip

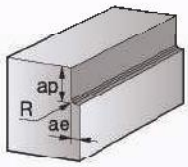


- Slotting depth(ap)
  - ap≤1.5D
  - Workpiece should be clamped rigidly in case of vibration, reduce RPM and feed rate by the same ratio

Recommended Cutting Condition (IFE4000, Shouldering)

Workpiece / Condition / Diameter(Ø)	Steel, Alloy steel (~ HRC20)		Steel, Alloy steel (HRC30~40)		Steel, Alloy steel (HRC40~)		Cast iron Graphite cast iron		Stainless steel Titanium alloy	
	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)
3	12,600	920	8,200	580	6,400	220	12,900	1,370	5,300	200
4	9,500	920	6,400	580	4,800	220	9,800	1,370	4,000	200
5	7,500	920	5,400	580	3,900	220	7,600	1,370	3,200	200
6	6,500	920	4,100	580	3,000	220	7,800	2,000	2,600	200
8	4,800	920	3,200	580	2,500	220	6,000	2,120	2,000	200
10	3,700	920	2,600	580	1,900	220	4,800	2,230	1,600	200
12	3,100	920	2,100	580	1,600	220	3,700	2,340	1,300	200
14	2,700	920	1,800	580	1,400	220	3,400	2,450	1,100	200
16	2,400	1020	1,500	690	1,200	270	3,000	2,520	1,000	225
18	2,000	1020	1,400	690	1,000	340	2,600	2,680	880	240
20	1,900	1020	1,300	690	900	340	2,400	2,680	800	240

Application tip

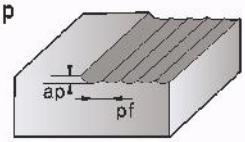


- Shouldering depth (ap) and radial depth (ae)
  - ap=1.5D
  - ae=0.1D
  - Workpiece should be clamped rigidly in case of vibration, reduce RPM and feed rate by the same ratio

Recommended Cutting Condition (IBE2000 Ball)

Workpiece / Condition / Diameter(Ø)	Steel, Alloy steel (~ HRC30)		Steel, Alloy steel (HRC30 ~)	
	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)
1	15,760	250	5,800	90
2	14,400	750	4,680	150
3	13,100	680	4,520	150
4	10,500	740	4,200	180
5	9,140	820	3,680	180
6	7,780	840	3,160	190
8	5,260	950	2,100	190
10	4,620	1,020	1,780	190
12	3,780	900	1,360	190
16	2,740	920	1,160	190
20	2,100	840	840	190

● Application tip

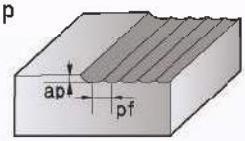


- ap=0.3D · pf=0.7D
- Workpiece should be clamped rigidly In case of vibration, reduce RPM and feed rate by the same ratio

Recommended Cutting Condition (IBE4000 Ball)

Workpiece / Condition / Diameter(Ø)	Steel, Alloy steel (~ HRC30)		Steel, Alloy steel (HRC30 ~)	
	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)
1	15,760	380	5,800	130
2	15,760	800	4,840	160
3	13,100	1,020	4,520	220
4	10,500	1,110	4,200	270
5	9,140	1,230	3,680	270
6	7,780	1,260	3,160	280
8	5,260	1,430	2,100	280
10	4,620	1,530	1,780	280
12	3,780	1,350	1,360	280
16	2,740	1,380	1,160	280
20	2,100	1,260	840	280

● Application tip

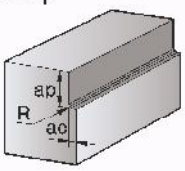


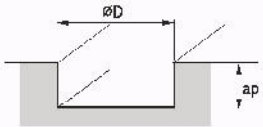
- ap=0.3D · pf=0.7D
- Workpiece should be clamped rigidly In case of vibration, reduce RPM and feed rate by the same ratio

Recommended Cutting Condition (IRE2000 Radius)

Workpiece / Condition / Diameter(Ø)	Steel, Alloy steel (~ HRC30)		Steel, Alloy steel (HRC30 ~)	
	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)
3	4,410	70	2,200	30
4	3,570	85	1,790	35
5	3,050	105	1,580	40
6	2,630	125	1,370	50
8	2,000	135	1,050	50
10	1,680	135	840	50
12	1,370	105	700	40
16	1,160	95	560	35
20	840	70	420	25

Application tip





- Workpiece should be clamped rigidly in case of vibration, reduce RPM and feed rate by the same ratio

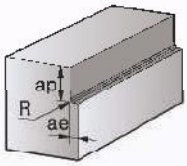
■ Shouldering depth (ap) and radial depth (ae)
- ap=1.5D
- ae=0.1D

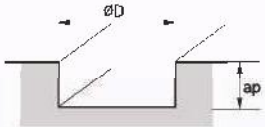
■ Slotting depth(ap)
- ap≤1.5D

Recommended Cutting Condition (IRE4000 Radius)

Workpiece / Condition / Diameter(Ø)	Steel, Alloy steel (~ HRC30)		Steel, Alloy steel (HRC30 ~)	
	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)
3	4,410	115	2,200	55
4	3,570	140	1,790	60
5	3,050	180	1,580	70
6	2,630	215	1,370	85
8	2,000	230	1,050	85
10	1,680	230	840	85
12	1,370	180	700	70
16	1,160	160	560	60
20	840	115	420	45

Application tip





- Workpiece should be clamped rigidly in case of vibration, reduce RPM and feed rate by the same ratio

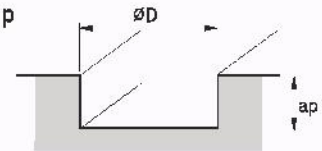
■ Shouldering depth (ap) and radial depth (ae)
- ap=1.5D
- ae=0.1D

■ Slotting depth(ap)
- ap≤1.5D

Recommended Cutting Condition (FE2000, Slotting)

Workpiece / Condition / Diameter(Ø)	Steel, Alloy steel (HRC20 ~)		Steel, Alloy steel (HRC30~40)		Stainless steel Titanium alloy		Cast iron Graphite cast iron		Aluminum alloy		Copper Non-ferrous metal	
	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)	R.P.M n(min⁻¹)	Feed vf(mm/min)
1	11,000	55	8,000	40	16,000	45	13,000	120	32,000	300	24,000	240
2	5,500	80	4,000	55	8,000	65	6,500	150	16,000	320	12,000	240
3	3,700	90	2,600	60	5,300	65	4,200	150	11,000	320	8,000	240
4	2,800	90	2,000	60	4,000	65	3,200	150	8,000	320	6,000	240
5	2,200	90	1,600	60	3,200	65	2,500	150	6,400	320	4,800	240
6	1,800	90	1,000	60	2,600	65	2,100	180	5,300	340	4,000	260
8	1,400	90	1,000	60	1,300	65	1,600	190	4,000	340	3,000	260
10	1,100	90	800	60	2,000	65	1,300	200	3,200	340	2,400	260
12	900	90	660	60	1,600	65	1,000	210	2,600	340	2,000	260
14	800	90	570	60	1,100	65	900	220	2,300	340	1,700	260
16	700	100	500	75	1,000	75	800	225	2,000	340	1,500	260
18	600	100	440	75	880	80	700	240	1,800	340	1,300	260
20	550	100	400	75	800	80	640	240	1,600	340	1,200	260

Application tip

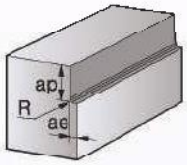


- Slotting depth(ap)
  - ap≤0.5D(D > Ø3)
  - ap≤1.0D(D < Ø3)
  - Workpiece should be clamped rigidly in case of vibration, reduce RPM and feed rate by the same ratio

Recommended Cutting Condition (FE4000, Shouldering)

Workpiece / Condition / Diameter(Ø)	Steel, Alloy steel (HRC20 ~)		Steel, Alloy steel (HRC30~40)		Stainless steel Titanium alloy		Cast iron Graphite cast iron		Aluminum alloy		Copper Non-ferrous metal	
	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)	R.P.M n(min⁻¹)	Feed vf(mm/min)
3	3,700	270	2,600	180	5,300	200	4,200	450	11,000	960	8,000	720
4	2,800	270	2,000	180	4,000	200	3,200	450	8,000	960	6,000	720
5	2,200	270	1,600	180	3,200	200	2,500	450	6,400	960	4,800	720
6	1,800	270	1,000	180	2,600	200	2,100	540	5,300	1,020	4,000	780
8	1,400	270	1,000	180	1,300	200	1,600	570	4,000	1,020	3,000	780
10	1,100	270	800	180	2,000	200	1,300	600	3,200	1,020	2,400	780
12	900	270	660	180	1,600	200	1,000	630	2,600	1,020	2,000	780
14	800	270	570	180	1,100	200	900	660	2,300	1,020	1,700	780
16	700	300	500	220	1,000	225	800	680	2,000	1,020	1,500	780
18	600	300	440	220	880	240	700	720	1,800	1,020	1,300	780
20	550	300	400	220	800	240	640	720	1,600	1,020	1,200	780

Application tip



- Shouldering depth (ap) and radial depth (ae)
  - ap=1.5D
  - ae=0.1D
  - Workpiece should be clamped rigidly in case of vibration, reduce RPM and feed rate by the same ratio

IFE2000 / 3000 (Flat) Standard

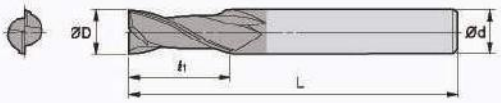


Fig. 1

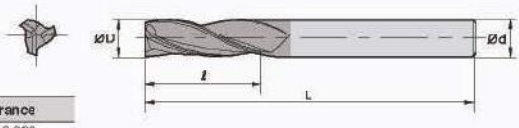


Fig. 2

H-A 30°

TiAlN

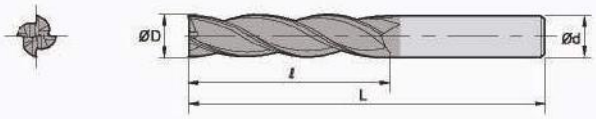
Substrate PC220

ØD	Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020
Ø8.5~Ø11.5	0 ~ - 0.025
Ø12.0~Ø20.0	0 ~ - 0.030

(mm)

Designation		ØD	Ød	ℓ	L	Fig.
IFE	2010-040	1	6	2.5	40	1
	2015-040	1.5	6	4	40	1
	2020-040	2	6	6	40	1
	2025-040	2.5	6	8	40	1
	2030-045	3	6	8	45	1
	2035-045	3.5	6	10	45	1
	2040-045	4	6	11	45	1
	2045-045	4.5	6	11	45	1
	2050-050	5	6	13	50	1
	2055-050	5.5	6	13	50	1
	2060-050	6	6	13	50	1
	2065-060	6.5	8	16	60	1
	2070-060	7	8	16	60	1
	2075-060	7.5	8	16	60	1
	2080-060	8	8	19	60	1
	2085-070	8.5	10	19	70	1
	2090-070	9	10	19	70	1
	2095-070	9.5	10	19	70	1
	2100-070	10	10	22	70	1
	2105-075	10.5	12	22	75	1
	2110-075	11	12	22	75	1
	2115-075	11.5	12	22	75	1
	2120-075	12	12	26	75	1
	2130-085	13	16	26	85	1
	2140-085-S14	14	14	26	85	1
	2140-085	14	16	26	85	1
	2150-090	15	16	26	90	1
	2160-100	16	16	32	100	1
	2180-100-S18	18	18	32	100	1
	2180-100	18	20	32	100	1
	2200-105	20	20	38	105	1
IFE	3020-040	2	6	6	40	2
	3030-045	3	6	8	45	2
	3040-045	4	6	11	45	2
	3050-050	5	6	13	50	2
	3060-050	6	6	13	50	2
	3070-060	7	8	16	60	2
	3080-060	8	8	19	60	2
	3090-070	9	10	19	70	2
	3100-070	10	10	22	70	2
	3110-075	11	12	22	75	2
	3120-075	12	12	26	75	2
	3130-085	13	16	26	85	2
	3140-085-S14	14	14	26	85	2
	3140-085	14	16	26	85	2
	3150-090	15	16	26	90	2
	3160-100	16	16	32	100	2

IFE4000 (Flat) Standard



ØD	Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020
Ø8.5~Ø11.5	0 ~ - 0.025
Ø12.0~C20.0	0 ~ - 0.030

(mm)

Designation		ØD	Ød	ℓ	L
IFE	4025-040	2.5	6	8	40
	4030-045	3	6	8	45
	4035-045	3.5	6	10	45
	4040-045	4	6	11	45
	4045-045	4.5	6	11	45
	4050-050	5	6	13	50
	4055-050	5.5	6	13	50
	4060-050	6	6	13	60
	4065-060	6.5	8	16	60
	4070-060	7	8	16	60
	4075-060	7.5	8	16	60
	4080-060	8	8	19	60
	4085-070	8.5	10	19	70
	4090-070	9	10	19	70
	4095-070	9.5	10	19	70
	4100-070	10	10	22	70
	4105-075	10.5	12	22	75
	4110-075	11	12	22	75
	4115-075	11.5	12	22	75
	4120-075	12	12	26	75
	4130-085	13	16	26	85
	4140-085-S14	14	14	26	85
	4140-085	14	16	26	85
	4150-090	15	16	26	90
	4160-100	16	16	32	100
	4160-100-S18	16	18	32	100
	4180-100	18	20	32	100
	4200-105	20	20	38	105

IFE2000/4000 (Long Flat)

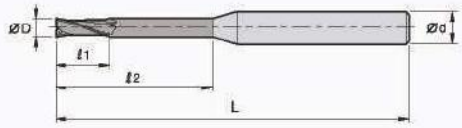


Fig. 1

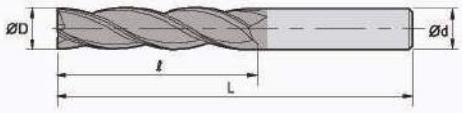


Fig. 2

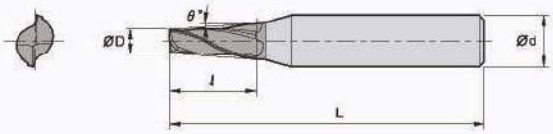
2 | 4 | H·A 30° | TiAlN | Substrate PC220

ØD	Tolerance
Ø1.0~Ø8.0	0~-0.020
Ø8.5~Ø11.5	0~-0.025
Ø12.0~Ø20.0	0~-0.030

(mm)

Designation		ØD	Ød	ℓ1	ℓ2	L	Fig.
IFE 2	2030-050	3	6	12	15	50	1
	2040-050	4	6	15	20	50	1
	2050-060	5	6	20	25	60	1
	2060-060	6	6	20	-	60	1
	2080-070	8	8	25	-	70	1
	2100-090	10	10	30	-	90	1
	2120-090	12	12	30	-	90	1
	2140-110-S14	14	14	40	-	110	1
	2140-110	14	16	40	45	110	1
	2160-110	16	16	50	-	110	1
	2180-110-S18	18	18	50	-	110	1
	2180-110	18	20	50	55	110	1
	2200-110	20	20	55	-	110	1
IFE 4	4030-050	3	6	12	15	50	2
	4040-050	4	6	15	20	50	2
	4050-060	5	6	20	25	60	2
	4060-060	6	6	20	-	60	2
	4080-070	8	8	25	-	70	2
	4100-090	10	10	30	-	90	2
	4120-090	12	12	30	-	90	2
	4140-110-S14	14	14	40	-	110	2
	4140-110	14	16	40	45	110	2
	4160-110	16	16	50	-	110	2
	4180-110-S18	18	18	50	-	110	2
	4180-110	18	20	50	55	110	2
	4200-110	20	20	55	-	110	2

IFE2000-T (Taper Flat)



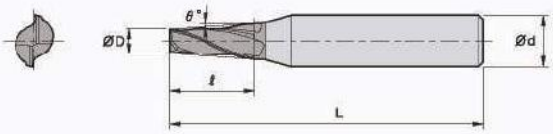
2 | H·A 30° | TIAIN | Substrate PC220

ØD	Tolerance
Ø1.0~Ø6.0	0 ~ - 0.020
Ø8.5~Ø11.5	0 ~ - 0.025
Ø12.0~Ø20.0	0 ~ - 0.030

(mm)

Designation		ØD	Ød	L	ℓ	θ°
IFE	2030-045-T05	3	6	45	10	0.5°
2	2030-045-T10	3	6	45	10	1°
	2030-045-T15	3	6	45	10	1.5°
	2030-045-T20	3	6	45	10	2°
	2030-045-T25	3	6	45	10	2.5°
	2030-045-T30	3	6	45	10	3°
	2040-045-T05	4	6	45	12	0.5°
	2040-045-T10	4	6	45	12	1°
	2040-045-T15	4	6	45	12	1.5°
	2040-045-T20	4	6	45	12	2°
	2040-045-T25	4	6	45	12	2.5°
	2040-045-T30	4	6	45	12	3°
	2050-050-T05	5	6	50	15	0.5°
	2050-050-T10	5	6	50	15	1°
	2050-050-T15	5	6	50	15	1.5°
	2050-050-T20	5	8	50	15	2°
	2050-050-T25	5	8	50	15	2.5°
	2050-050-T30	5	8	50	15	3°
	2060-050-T05	6	8	50	15	0.5°
	2060-050-T10	6	8	50	15	1°
	2060-050-T15	6	8	50	15	1.5°
	2060-050-T20	6	8	50	15	2°
	2060-050-T25	6	8	50	15	2.5°
	2060-050-T30	6	8	50	15	3°
	2080-060-T05	8	10	60	20	0.5°
	2080-060-T10	8	10	60	20	1°
	2080-060-T15	8	10	60	20	1.5°
	2080-060-T20	8	10	60	20	2°
	2080-060-T25	8	10	60	20	2.5°
	2080-060-T30	8	12	60	20	3°
	2100-070-T05	10	12	70	25	0.5°
	2100-070-T10	10	12	70	25	1°
	2100-070-T15	10	12	70	25	1.5°
	2100-070-T20	10	12	70	25	2°
	2100-070-T25	10	14	70	25	2.5°
	2100-070-T30	10	14	70	25	3°

IFE2000-T (Taper Flat)



ØD	Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020
Ø8.5~Ø11.5	0 ~ - 0.025
Ø12.0~Ø20.0	0 ~ - 0.030

(mm)

Designation		ØD	Ød	L	ℓ	θ°
IFE	2110-070-T05	11	12	70	25	0.5°
2	2110-070-T10	11	12	70	25	1°
	2110-070-T15	11	14	70	25	1.5°
	2110-070-T20	11	14	70	25	2°
	2110-070-T25	11	14	70	25	2.5°
	2110-070-T30	11	14	70	25	3°
	2120-075-T05	12	14	75	30	0.5°
	2120-075-T10	12	14	75	30	1°
	2120-075-T15	12	14	75	30	1.5°
	2120-075-T20	12	16	75	30	2°
	2120-075-T25	12	16	75	30	2.5°
	2120-075-T30	12	16	75	30	3°
	2130-075-T05	13	14	75	30	0.5°
	2130-075-T10	13	14	75	30	1°
	2130-075-T15	13	16	75	30	1.5°
	2130-075-T20	13	16	75	30	2°
	2130-075-T25	13	16	75	30	2.5°
	2130-075-T30	13	18	75	30	3°
	2140-080-T05	14	16	80	35	0.5°
	2140-080-T10	14	16	80	35	1°
	2140-080-T15	14	16	80	35	1.5°
	2140-080-T20	14	18	80	35	2°
	2140-080-T25	14	18	80	35	2.5°
	2140-080-T30	14	18	80	35	3°
	2150-080-T05	15	18	80	35	0.5°
	2150-080-T10	15	18	80	35	1°
	2150-080-T15	15	18	80	35	1.5°
	2150-080-T20	15	18	80	35	2°
	2150-080-T25	15	20	80	35	2.5°
	2150-080-T30	15	20	80	35	3°
	2160-090-T05	16	20	90	40	0.5°
	2160-090-T10	16	20	90	40	1°
	2160-090-T15	16	20	90	40	1.5°
	2160-090-T20	16	20	90	40	2°
	2160-090-T25	16	20	90	40	2.5°
	2160-090-T30	16	22	90	40	3°

IBE2000 / 4000 (Ball) Standard

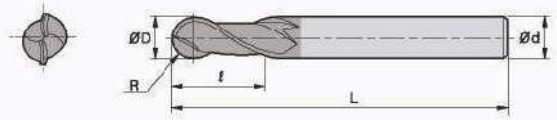


Fig. 1

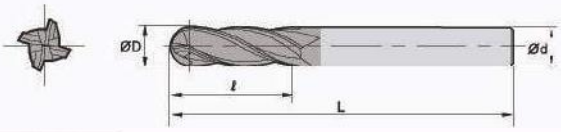


Fig. 2

H·A 30°

TiAlN

Substrate PC220

ØD	Tolerance	R Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020	±0.01
Ø9.0~Ø10.0	0 ~ - 0.025	±0.01
Ø12.0~Ø20.0	0 ~ - 0.030	±0.01

(mm)

Designation		R	ØD	Ød	ℓ	L	Fig.
IBE	2010-050	0.5	1	6	2.5	50	1
	2015-050	0.75	1.5	6	4	50	1
	2020-050	1	2	6	5	50	1
	2025-060	1.25	2.5	6	6	60	1
	2030-060	1.5	3	6	8	60	1
	2035-070	1.75	3.5	6	8	70	1
	2040-070	2	4	6	8	70	1
	2050-080	2.5	5	6	10	80	1
	2060-090	3	6	6	12	90	1
	2070-090	3.5	7	8	14	90	1
	2080-100	4	8	8	14	100	1
	2090-100	4.5	9	10	18	100	1
	2100-100	5	10	10	18	100	1
	2120-110	6	12	12	22	110	1
	2140-110-S14	7	14	14	26	110	1
	2140-110	7	14	16	26	110	1
	2160-140	8	16	16	30	140	1
	2180-140-S18	9	18	18	34	140	1
	2180-140	9	18	20	34	140	1
	2200-160	10	20	20	36	160	1
IBE	4030-060	1.5	3	6	8	60	2
	4040-070	2	4	6	8	70	2
	4050-080	2.5	5	6	10	80	2
	4060-090	3	6	6	12	90	2
	4070-090	3.5	7	8	14	90	2
	4080-100	4	8	8	14	100	2
	4100-100	5	10	10	18	100	2
	4120-110	6	12	12	22	110	2
	4160-140	8	16	16	30	140	2
	4200-160	10	20	20	36	160	2

IBE2000 (Long Ball)

H·A 30°

TiAlN

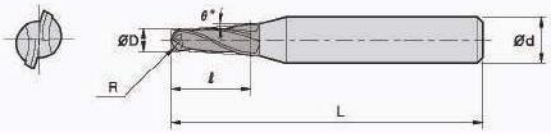
Substrate PC220

ØD	Tolerance	R Tolerance
Ø1.0~Ø6.0	0~-0.020	±0.01
Ø9.0~Ø10.0	0~-0.025	±0.01
Ø12.0~Ø20.0	0~-0.030	±0.01

(mm)

	Designation	R	ØD	Ød	ℓ	L
IBE	2030-100	1.5	3	6	7	100
	2040-100	2	4	6	9	100
	2060-115	3	6	6	12	115
	2080-140	4	8	8	16	140
	2100-180	5	10	10	20	180
	2120-200	6	12	12	23	200
	2160-250	8	16	16	30	250
	2200-250	10	20	20	38	250

IBE2000-T (Taper Ball)



H·A 30°

TiAlN

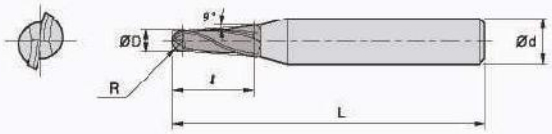
Substrate PC220

ØD	Tolerance	R Tolerance
Ø1.0~Ø6.0	0~-0.020	±0.01
Ø9.0~Ø10.0	0~-0.025	±0.01
Ø12.0~Ø20.0	0~-0.030	±0.01

(mm)

	Designation	R	ØD	Ød	ℓ	L	θ°
IBE	2030-045-T05	1.5	3	6	10	45	0.5°
	2030-045-T10	1.5	3	6	10	45	1°
	2030-045-T15	1.5	3	6	10	45	1.5°
	2030-045-T20	1.5	3	6	10	45	2°
	2030-045-T25	1.5	3	6	10	45	2.5°
	2030-045-T30	1.5	3	6	10	45	3°
	2040-045-T05	2	4	6	12	45	0.5°
	2040-045-T10	2	4	6	12	45	1°
	2040-045-T15	2	4	6	12	45	1.5°
	2040-045-T20	2	4	6	12	45	2°
	2040-045-T25	2	4	6	12	45	2.5°
	2040-045-T30	2	4	6	12	45	3°
	2050-050-T05	2.5	5	6	15	50	0.5°
	2050-050-T10	2.5	5	6	15	50	1°
	2050-050-T15	2.5	5	6	15	50	1.5°
	2050-050-T20	2.5	5	6	15	50	2°
	2050-050-T25	2.5	5	8	15	50	2.5°
	2050-050-T30	2.5	5	8	15	50	3°
	2060-050-T05	3	6	8	15	50	0.5°
	2060-050-T10	3	6	8	15	50	1°
	2060-050-T15	3	6	8	15	50	1.5°
	2060-050-T20	3	6	8	15	50	2°
	2060-050-T25	3	6	8	15	50	2.5°

IBE2000-T (Taper Ball)



H·A 30°

TIAIN

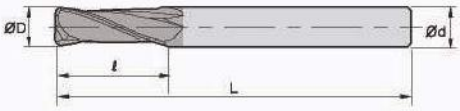
Substrate PC220

ØD	Tolerance	R Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020	±0.01
Ø9.0~Ø10.0	0 ~ - 0.025	±0.01
Ø12.0~Ø20.0	0 ~ - 0.030	±0.01

(mm)

Designation		R	ØD	Ød	ℓ	L	θ°
IBE	2060-050-T30	3	6	8	15	50	3°
	2080-060-T05	4	8	10	20	60	0.5°
	2080-060-T10	4	8	10	20	60	1°
	2080-060-T15	4	8	10	20	60	1.5°
	2080-060-T20	4	8	10	20	60	2°
	2080-060-T25	4	8	10	20	60	2.5°
	2080-060-T30	4	8	10	20	60	3°
	2100-070-T05	5	10	12	25	70	0.5°
	2100-070-T10	5	10	12	25	70	1°
	2100-070-T15	5	10	12	25	70	1.5°
	2100-070-T20	5	10	12	25	70	2°
	2100-070-T25	5	10	12	25	70	2.5°
	2100-070-T30	5	10	14	25	70	3°
	2110-070-T05	5.5	11	12	25	70	0.5°
	2110-070-T10	5.5	11	12	25	70	1°
	2110-070-T15	5.5	11	14	25	70	1.5°
	2110-070-T20	5.5	11	14	25	70	2°
	2110-070-T25	5.5	11	14	25	70	2.5°
	2110-070-T30	5.5	11	14	25	70	3°
	2120-075-T05	6	12	14	30	75	0.5°
	2120-075-T10	6	12	14	30	75	1°
	2120-075-T15	6	12	14	30	75	1.5°
	2120-075-T20	6	12	14	30	75	2°
	2120-075-T25	6	12	16	30	75	2.5°
	2120-075-T30	6	12	16	30	75	3°
	2130-075-T05	6.5	13	14	30	75	0.5°
	2130-075-T10	6.5	13	14	30	75	1°
	2130-075-T15	6.5	13	16	30	75	1.5°
	2130-075-T20	6.5	13	16	30	75	2°
	2130-075-T25	6.5	13	16	30	75	2.5°
	2130-075-T30	6.5	13	16	30	75	3°
	2140-080-T05	7	14	16	35	80	0.5°
	2140-080-T10	7	14	16	35	80	1°
	2140-080-T15	7	14	16	35	80	1.5°
	2140-080-T20	7	14	18	35	80	2°
	2140-080-T25	7	14	18	35	80	2.5°
	2140-080-T30	7	14	18	35	80	3°
	2150-080-T05	7.5	15	18	35	80	0.5°
	2150-080-T10	7.5	15	18	35	80	1°
	2150-080-T15	7.5	15	18	35	80	1.5°
	2150-080-T20	7.5	15	18	35	80	2°
	2150-080-T25	7.5	15	20	35	80	2.5°
	2150-080-T30	7.5	15	20	35	80	3°
	2160-090-T05	8	16	20	40	90	0.5°
	2160-090-T10	8	16	20	40	90	1°
	2160-090-T15	8	16	20	40	90	1.5°
	2160-090-T20	8	16	20	40	90	2°
	2160-090-T25	8	16	20	40	90	2.5°
	2160-090-T30	8	16	20	40	90	3°

IRE2000 (Radius)

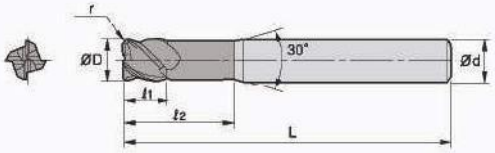


ØD	Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020
Ø8.5~Ø10.5	0 ~ - 0.025
Ø12.0~Ø20.0	0 ~ - 0.030

(mm)

	Designation	ØD	Ød	ℓ_1	ℓ_2	L	r
IRE	2030-050-R03	3	6	12	14	50	0.3
2	2040-050-R03	4	6	15	16	50	0.3
	2040-050-R05	4	6	15	16	50	0.5
	2050-060-R03	5	6	15	16	60	0.3
	2050-060-R05	5	6	15	16	60	0.5
	2060-060-R03	6	6	20		60	0.3
	2060-060-R05	6	6	20		60	0.5
	2060-060-R10	6	6	20	-	60	1
	2080-070-R03	8	6	25	-	70	0.3
	2080-070-R05	8	8	25	-	70	0.5
	2080-070-R10	8	8	25	-	70	1
	2080-070-R15	8	8	25	-	70	1.5
	2080-070-R20	8	6	25	-	70	2
	2100-090-R03	10	10	30	-	90	0.3
	2100-090-R05	10	10	30		90	0.5
	2100-090-R10	10	10	30	-	90	1
	2100-090-R15	10	10	30	-	90	1.5
	2100-090-R20	10	10	30	-	90	2
	2120-090-R05	12	12	30	-	90	0.5
	2120-090-R10	12	12	30	-	90	1
	2120-090-R15	12	12	30	-	90	1.5
	2120-090-R20	12	12	30	-	90	2
	2160-110-R05	16	16	50	-	110	0.5
	2160-110-R10	16	16	50		110	1
	2160-110-R15	16	16	50	-	110	1.5
	2160-110-R20	16	16	50	-	110	2
	2200-110-R05	20	20	55	-	110	0.5
	2200-110-R10	20	20	55	-	110	1
	2200-110-R15	20	20	55	-	110	1.5
	2200-110-R20	20	20	55	-	110	2

IRE4000 (Radius)



4 | H-A 30° | TiAlN | Substrate PC220

ØD	Tolerance
Ø1.0~Ø6.0	0 ~ - 0.020
Ø8.5~Ø10.5	0 ~ - 0.025
Ø12.0~Ø20.0	0 ~ - 0.030

(mm)

Designation		ØD	Ød	ℓ1	ℓ2	L	r
IRE	4030-050-R03	3	6	12	14	50	0.3
4	4040-050-R03	4	6	15	16	50	0.3
	4040-050-R05	4	6	15	16	50	0.5
	4050-060-R03	5	6	15	16	60	0.3
	4050-060-R05	5	6	15	16	60	0.5
	4060-060-R03	6	6	20		60	0.3
	4060-060-R05	6	6	20		60	0.5
	4060-060-R10	6	6	20	-	60	1
	4080-070-R03	8	8	25	-	70	0.3
	4080-070-R05	8	8	25	-	70	0.5
	4080-070-R10	8	8	25	-	70	1
	4080-070-R15	8	8	25	-	70	1.5
	4080-070-R20	8	8	25	-	70	2
	4100-090-R03	10	10	30	-	90	0.3
	4100-090-R05	10	10	30		90	0.5
	4100-090-R10	10	10	30	-	90	1
	4100-090-R15	10	10	30	-	90	1.5
	4100-090-R20	10	10	30	-	90	2
	4120-090-R05	12	12	30	-	90	0.5
	4120-090-R10	12	12	30	-	90	1
	4120-090-R15	12	12	30	-	90	1.5
	4120-090-R20	12	12	30	-	90	2
	4160-110-R05	16	16	50	-	110	0.5
	4160-110-R10	16	16	50		110	1
	4160-110-R15	16	16	50	-	110	1.5
	4160-110-R20	16	16	50	-	110	2
	4200-110-R05	20	20	55	-	110	0.5
	4200-110-R10	20	20	55	-	110	1
	4200-110-R15	20	20	55	-	110	1.5
	4200-110-R20	20	20	55	-	110	2

FE2000 / 3000 (Flat) Standard

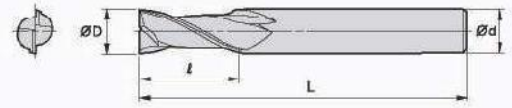


Fig. 1

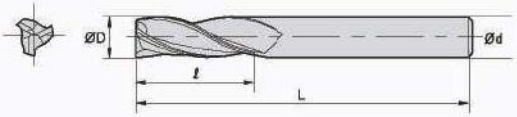


Fig. 2

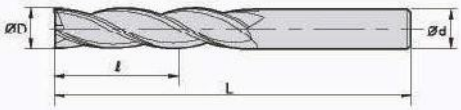
Carbide | Substrate FA2

ØD	Tolerance
Ø1.0~Ø8.0	0~-0.020
Ø8.5~Ø11.5	0~-0.025
Ø12.0~Ø20.0	0~-0.030

(mm)

	Designation	ØD	Ød	ℓ	L	Fig.
FE	2010-040	1	6	2.5	40	1
	2015-040	1.5	6	4	40	1
	2020-040	2	6	6	40	1
	2025-040	2.5	6	8	40	1
	2030-045	3	6	8	45	1
	2035-045	3.5	6	10	45	1
	2040-045	4	6	11	45	1
	2045-045	4.5	6	11	45	1
	2050-050	5	6	13	50	1
	2055-050	5.5	6	13	50	1
	2060-050	6	6	13	50	1
	2065-060	6.5	8	15	60	1
	2070-060	7	8	15	60	1
	2075-060	7.5	8	15	60	1
	2080-060	8	8	19	60	1
	2085-070	8.5	10	19	70	1
	2090-070	9	10	19	70	1
	2095-070	9.5	10	19	70	1
	2100-070	10	10	22	70	1
	2105-075	10.5	12	22	75	1
	2110-075	11	12	22	75	1
	2115-075	11.5	12	22	75	1
	2120-075	12	12	25	75	1
	2130-085	13	16	25	85	1
	2140-085-S14	14	14	25	85	1
	2140-085	14	16	25	85	1
	2150-090	15	16	25	90	1
	2160-100	16	16	32	100	1
	2180-100-S18	18	18	32	100	1
	2180-100	18	20	32	100	1
	2200-105	20	20	38	105	1
FE	3020-040	2	6	6	40	2
	3030-045	3	6	8	45	2
	3040-045	4	6	11	45	2
	3050-050	5	6	13	50	2
	3060-050	6	6	13	50	2
	3070-060	7	8	15	60	2
	3080-060	8	8	19	60	2
	3090-070	9	10	19	70	2
	3100-070	10	10	22	70	2
	3110-075	11	12	22	75	2
	3120-075	12	12	25	75	2
	3130-085	13	16	25	85	2
	3140-085-S14	14	14	25	85	2
	3140-085	14	16	25	85	2
	3150-090	15	16	25	90	2
	3160-100	16	16	32	100	2

FE4000 (Flat) Standard



ØD	Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020
Ø8.5~Ø11.5	0 ~ - 0.025
Ø12.0~Ø20.0	0 ~ - 0.030

(mm)

Designation		ØD	Ød	ℓ	L
FE	4025-040	2.5	6	8	40
	4030-045	3	6	8	45
	4035-045	3.5	6	10	45
	4040-045	4	6	11	45
	4045-045	4.5	6	11	45
	4050-050	5	6	13	50
	4055-050	5.5	6	13	50
	4060-050	6	6	13	50
	4065-060	6.5	8	16	60
	4070-060	7	8	16	60
	4075-060	7.5	8	16	60
	4080-060	8	8	19	60
	4085-070	8.5	10	19	70
	4090-070	9	10	19	70
	4095-070	9.5	10	19	70
	4100-070	10	10	22	70
	4105-075	10.5	12	22	75
	4110-075	11	12	22	75
	4115-075	11.5	12	22	75
	4120-075	12	12	26	75
	4130-085	13	16	26	85
	4140-085-S14	14	14	26	85
	4140-085	14	16	26	85
	4150-090	15	16	26	90
	4160-100	16	16	32	100
	4180-100-S18	18	18	32	100
	4180-100	18	20	32	100
	4200-105	20	20	38	105

FE2000 / 4000 (Long Flat)

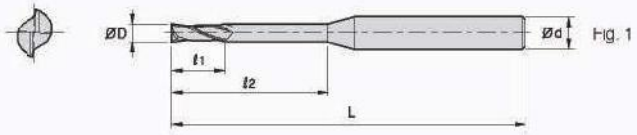


Fig. 1

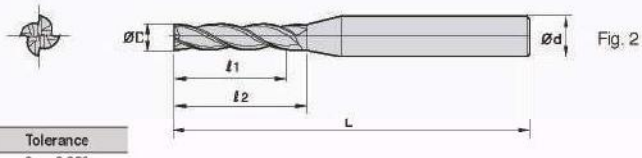


Fig. 2

Carbide

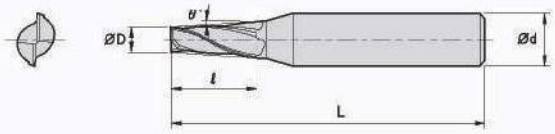
Substrate FA2

OD	Tolerance
Ø1.0~Ø8.0	0~-0.020
Ø8.5~Ø11.5	0~-0.025
Ø12.0~Ø20.0	0~-0.030

(mm)

Designation		ØD	Ød	ℓ1	ℓ2	L	Fig.
FE 2	2030-050	3	6	12	15	50	1
	2040-050	4	6	15	20	50	1
	2050-060	5	6	20	25	60	1
	2060-060	6	6	20	-	60	1
	2080-070	8	8	25	-	70	1
	2100-090	10	10	30	-	90	1
	2120-090	12	12	30	-	90	1
	2140-110-S14	14	14	40	-	110	1
	2140-110	14	16	40	45	110	1
	2160-110	16	16	50	-	110	1
	2180-110-S18	18	18	50	-	110	1
	2180-110	18	20	50	55	110	1
	2200-110	20	20	55	-	110	1
FE 4	4030-050	3	6	12	15	50	2
	4040-050	4	6	15	20	50	2
	4050-060	5	6	20	25	60	2
	4060-060	6	6	20	-	60	2
	4080-070	8	8	25	-	70	2
	4100-090	10	10	30	-	90	2
	4120-090	12	12	30	-	90	2
	4140-110-S14	14	14	40	-	110	2
	4140-110	14	16	40	45	110	2
	4160-110	16	16	50	-	110	2
	4180-110-S18	18	18	50	-	110	2
	4180-110	18	20	50	55	110	2
	4200-110	20	20	55	-	110	2

FE2000-T (Taper Flat)



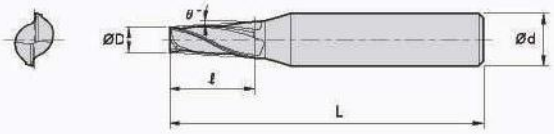
2 | H·A 30° | Carbide | Substrate FA2

CD	Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020
Ø8.5~Ø11.5	0 ~ - 0.025
Ø12.0~Ø20.0	0 ~ - 0.030

(mm)

Designation		ØD	Ød	ℓ	L	θ°
FE	2030-045-T05	3	6	10	45	0.5°
2	2030-045-T10	3	6	10	45	1°
	2030-045-T15	3	6	10	45	1.5°
	2030-045-T20	3	6	10	45	2°
	2030-045-T25	3	6	10	45	2.5°
	2030-045-T30	3	6	10	45	3°
	2040-045-T05	4	6	12	45	0.5°
	2040-045-T10	4	6	12	45	1°
	2040-045-T15	4	6	12	45	1.5°
	2040-045-T20	4	6	12	45	2°
	2040-045-T25	4	6	12	45	2.5°
	2040-045-T30	4	6	12	45	3°
	2050-050-T05	5	6	15	50	0.5°
	2050-050-T10	5	6	15	50	1°
	2050-050-T15	5	6	15	50	1.5°
	2050-050-T20	5	8	15	50	2°
	2050-050-T25	5	8	15	50	2.5°
	2050-050-T30	5	8	15	50	3°
	2060-050-T05	6	8	15	50	0.5°
	2060-050-T10	6	8	15	50	1°
	2060-050-T15	6	8	15	50	1.5°
	2060-050-T20	6	8	15	50	2°
	2060-050-T25	6	8	15	50	2.5°
	2060-050-T30	6	8	15	50	3°
	2080-060-T05	8	10	20	60	0.5°
	2080-060-T10	8	10	20	60	1°
	2080-060-T15	8	10	20	60	1.5°
	2080-060-T20	8	10	20	60	2°
	2080-060-T25	8	10	20	60	2.5°
	2080-060-T30	8	12	20	60	3°
	2100-070-T05	10	12	25	70	0.5°
	2100-070-T10	10	12	25	70	1°
	2100-070-T15	10	12	25	70	1.5°
	2100-070-T20	10	12	25	70	2°
	2100-070-T25	10	14	25	70	2.5°
	2100-070-T30	10	14	25	70	3°

FE2000-T (Taper Flat)



2 | H·A 30° | Carbide | Substrate FA2

ØD	Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020
Ø8.5~Ø11.5	0 ~ - 0.025
Ø12.0~Ø20.0	0 ~ - 0.030

(mm)

	Designation	ØD	Ød	ℓ	L	θ°
FE	2110-070-T05	11	12	25	70	0.5°
2	2110-070-T10	11	12	25	70	1°
	2110-070-T15	11	14	25	70	1.5°
	2110-070-T20	11	14	25	70	2°
	2110-070-T25	11	14	25	70	2.5°
	2110-070-T30	11	14	25	70	3°
	2120-075-T05	12	14	30	75	0.5°
	2120-075-T10	12	14	30	75	1°
	2120-075-T15	12	14	30	75	1.5°
	2120-075-T20	12	16	30	75	2°
	2120-075-T25	12	16	30	75	2.5°
	2120-075-T30	12	16	30	75	3°
	2130-075-T05	13	14	30	75	0.5°
	2130-075-T10	13	14	30	75	1°
	2130-075-T15	13	16	30	75	1.5°
	2130-075-T20	13	16	30	75	2°
	2130-075-T25	13	16	30	75	2.5°
	2130-075-T30	13	18	30	75	3°
	2140-080-T05	14	16	35	60	0.5°
	2140-080-T10	14	16	35	60	1°
	2140-080-T15	14	16	35	60	1.5°
	2140-080-T20	14	18	35	60	2°
	2140-080-T25	14	18	35	60	2.5°
	2140-080-T30	14	18	35	60	3°
	2150-080-T05	15	18	35	60	0.5°
	2150-080-T10	15	18	35	60	1°
	2150-080-T15	15	18	35	60	1.5°
	2150-080-T20	15	18	35	60	2°
	2150-080-T25	15	20	35	60	2.5°
	2150-080-T30	15	20	35	60	3°
	2160-090-T05	16	20	40	90	0.5°
	2160-090-T10	16	20	40	90	1°
	2160-090-T15	16	20	40	90	1.5°
	2160-090-T20	16	20	40	90	2°
	2160-090-T25	16	20	40	90	2.5°
	2160-090-T30	16	22	40	90	3°

BE2000 / 4000 (Ball)

Fig. 1

Fig. 2

Carbide

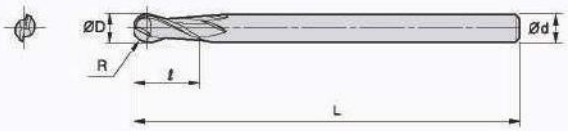
Substrate FA2

ØD	Tolerance	R Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020	±0.01
Ø9.0~Ø10.0	0 ~ - 0.025	±0.01
Ø12.0~Ø20.0	0 ~ - 0.030	±0.01

(mm)

Designation		R	ØD	Ød	ℓ	L	Fig.
BE	2010-050	0.5	1	6	2.5	50	1
	2015-050	0.75	1.5	6	4	50	1
	2020-050	1	2	6	5	50	1
	2025-060	1.25	2.5	6	6	60	1
	2030-060	1.5	3	6	8	60	1
	2035-070	1.75	3.5	6	8	70	1
	2040-070	2	4	6	8	70	1
	2050-080	2.5	5	6	10	80	1
	2060-090	3	6	6	12	90	1
	2070-090	3.5	7	8	14	90	1
	2080-100	4	8	8	14	100	1
	2090-100	4.5	9	10	18	100	1
	2100-100	5	10	10	18	100	1
	2120-110	6	12	12	22	110	1
	2140-110-S14	7	14	14	26	110	1
	2140-110	7	14	16	26	110	1
	2160-140	8	16	16	30	140	1
	2180-140-S18	9	18	18	34	140	1
	2180-140	9	18	20	34	140	1
	2200-160	10	20	20	36	160	1
BE	4030-060	1.5	3	6	8	60	2
	4040-070	2	4	6	8	70	2
	4050-080	2.5	5	6	10	80	2
	4060-090	3	6	6	12	90	2
	4070-090	3.5	7	8	14	90	2
	4080-100	4	8	8	14	100	2
	4100-100	5	10	10	18	100	2
	4120-110	6	12	12	22	110	2
	4160-140	8	16	16	30	140	2
	4200-160	10	20	20	36	160	2

BE2000 (Long Ball)



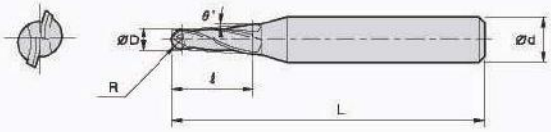
ØD	Tolerance	R Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020	±0.01
Ø9.0~Ø10.0	0 ~ - 0.025	±0.01
Ø12.0~Ø20.0	0 ~ - 0.030	±0.01

Substrate: FA2

(mm)

	Designation	R	ØD	Ød	ℓ	L
BE	2030-100	1.5	3	3	7	100
	2040-100	2	4	4	9	100
	2060-115	3	6	6	12	115
	2080-140	4	8	8	16	140
	2100-180	5	10	10	20	180
	2120-200	6	12	12	23	200
	2160-250	8	16	15	30	250
	2200-250	10	20	20	38	250

BE2000-T (Taper Ball)



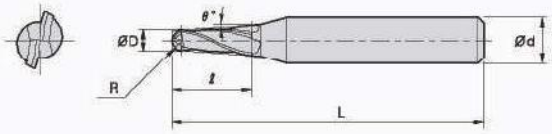
ØD	Tolerance	R Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020	±0.01
Ø9.0~Ø10.0	0 ~ - 0.025	±0.01
Ø12.0~Ø20.0	0 ~ - 0.030	±0.01

Substrate: FA2

(mm)

	Designation	R	ØD	Ød	ℓ	L	θ°
BE	2030-045-T05	1.5	3	6	10	45	0.5°
	2030-045-T10	1.5	3	6	10	45	1°
	2030-045-T15	1.5	3	6	10	45	1.5°
	2030-045-T20	1.5	3	6	10	45	2°
	2030-045-T25	1.5	3	6	10	45	2.5°
	2030-045-T30	1.5	3	6	10	45	3°
	2040-045-T05	2	4	6	12	45	0.5°
	2040-045-T10	2	4	6	12	45	1°
	2040-045-T15	2	4	6	12	45	1.5°
	2040-045-T20	2	4	6	12	45	2°
	2040-045-T25	2	4	6	12	45	2.5°
	2040-045-T30	2	4	6	12	45	3°
	2050-050-T05	2.5	5	6	15	50	0.5°
	2050-050-T10	2.5	5	6	15	50	1°
	2050-050-T15	2.5	5	6	15	50	1.5°
	2050-050-T20	2.5	5	6	15	50	2°
	2050-050-T25	2.5	5	8	15	50	2.5°
	2050-050-T30	2.5	5	8	15	50	3°
	2060-050-T05	3	6	8	15	50	0.5°
	2060-050-T10	3	6	8	15	50	1°
	2060-050-T15	3	6	8	15	50	1.5°
	2060-050-T20	3	6	8	15	50	2°
	2060-050-T25	3	6	8	15	50	2.5°
	2060-050-T30	3	6	8	15	50	3°

BE2000-T (Taper Ball)



2 | H·A 30° | Carbide | Substrate FA2

ØD	Tolerance	R Tolerance
Ø1.0~Ø8.0	0 ~ - 0.020	±0.01
Ø9.0~Ø10.0	0 ~ - 0.025	±0.01
Ø12.0~Ø20.0	0 ~ - 0.030	±0.01

(mm)

Designation		R	ØD	Ød	ℓ	L	θ°
BE	2080-060-T05	4	8	10	20	60	0.5°
	2080-060-T10	4	8	10	20	60	1°
	2080-060-T15	4	8	10	20	60	1.5°
	2080-060-T20	4	8	10	20	60	2°
	2080-060-T25	4	8	10	20	60	2.5°
	2080-060-T30	4	8	10	20	60	3°
	2100-070-T05	5	10	12	25	70	0.5°
	2100-070-T10	5	10	12	25	70	1°
	2100-070-T15	5	10	12	25	70	1.5°
	2100-070-T20	5	10	12	25	70	2°
	2100-070-T25	5	10	12	25	70	2.5°
	2100-070-T30	5	10	14	25	70	3°
	2110-070-T05	5.5	11	12	25	70	0.5°
	2110-070-T10	5.5	11	12	25	70	1°
	2110-070-T15	5.5	11	14	25	70	1.5°
	2110-070-T20	5.5	11	14	25	70	2°
	2110-070-T25	5.5	11	14	25	70	2.5°
	2110-070-T30	5.5	11	14	25	70	3°
	2120-075-T05	6	12	14	30	75	0.5°
	2120-075-T10	6	12	14	30	75	1°
	2120-075-T15	6	12	14	30	75	1.5°
	2120-075-T20	6	12	14	30	75	2°
	2120-075-T25	6	12	16	30	75	2.5°
	2120-075-T30	6	12	16	30	75	3°
	2130-075-T05	6.5	13	14	30	75	0.5°
	2130-075-T10	6.5	13	14	30	75	1°
	2130-075-T15	6.5	13	16	30	75	1.5°
	2130-075-T20	6.5	13	16	30	75	2°
	2130-075-T25	6.5	13	16	30	75	2.5°
	2130-075-T30	6.5	13	16	30	75	3°
	2140-080-T05	7	14	16	35	80	0.5°
	2140-080-T10	7	14	16	35	80	1°
	2140-080-T15	7	14	16	35	80	1.5°
	2140-080-T20	7	14	18	35	80	2°
	2140-080-T25	7	14	18	35	80	2.5°
	2140-080-T30	7	14	18	35	80	3°
	2150-080-T05	7.5	15	18	35	80	0.5°
	2150-080-T10	7.5	15	18	35	80	1°
	2150-080-T15	7.5	15	18	35	80	1.5°
	2150-080-T20	7.5	15	18	35	80	2°
	2150-080-T25	7.5	15	20	35	80	2.5°
	2150-080-T30	7.5	15	20	35	80	3°
	2160-090-T05	8	16	20	40	90	0.5°
	2160-090-T10	8	16	20	40	90	1°
	2160-090-T15	8	16	20	40	90	1.5°
	2160-090-T20	8	16	20	40	90	2°
	2160-090-T25	8	16	20	40	90	2.5°
	2160-090-T30	8	16	20	40	90	3°

Endmill series for general cutting

Z Endmill

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

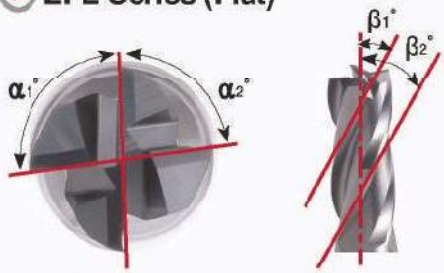
Features

before

After special edge treatment

- **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.

ZFE Series (Flat)



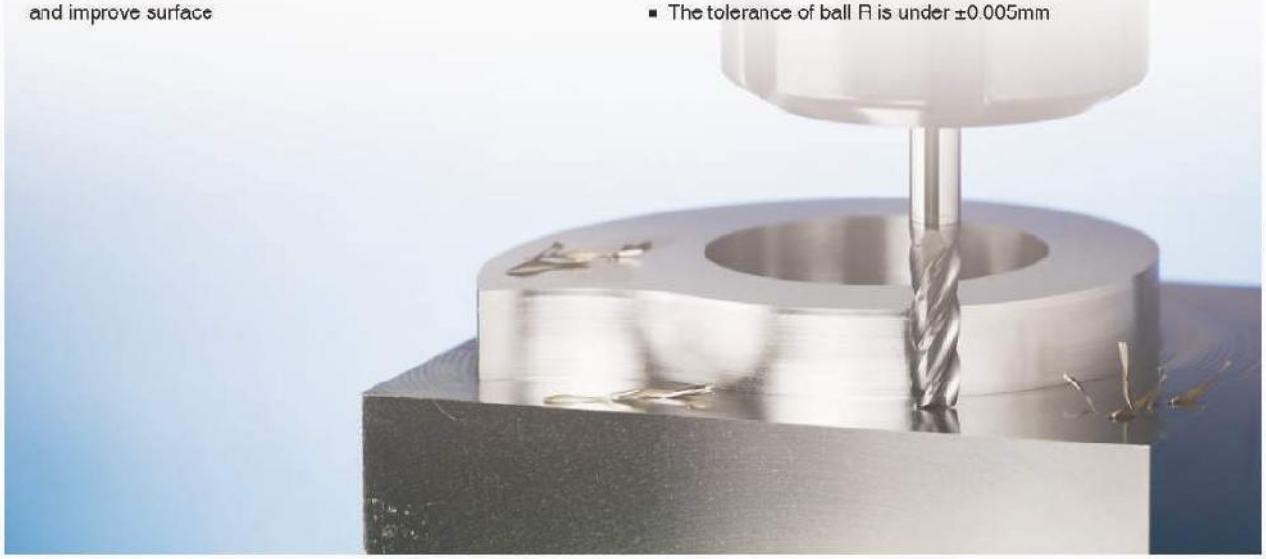
$\alpha_1° \neq \alpha_2°$, $\beta_1° \neq \beta_2°$ Irregular indexing & helix

- Irregular indexing & helix prevent chattering and improve surface

ZBE Series (Ball)

S shape of ball

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



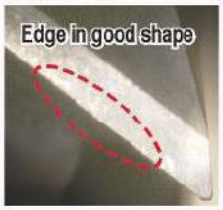
Cutting performance

Carbon steel [1045(AISI) / C45(DIN) / S45C(JIS), HRC20)]

- **Cutting conditions**
  - Diameter = Ø8.0
  - 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

Result

• Cutting edge treatment for less chipping



Z Endmill

Competitor

Carbon steel [1045(AISI) / C45(DIN) / S45C(JIS), HRC20)]

- **Cutting conditions**
  - Diameter = Ø8.0
  - 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** ZBE2080-100

Result

• New grade improves wear resistance

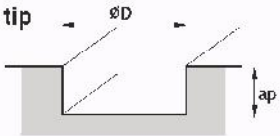
Z Endmill

Competitor

Recommended cutting conditions (ZFE2000 / ZSFE2000 Flat)

Workpiece / Condition / Diameter(Ø)	Alloy steel and 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

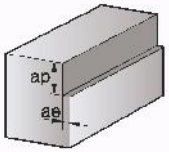


- **Slotting depth(ap)**
  - Ø3 ≥ D (ap 0.2D)
  - D > Ø3 (ap 0.5D)
  - Workpiece should be clamped rigidly. In case of vibration, reduce R.P.M and feed rate by the same ratio

Recommended cutting conditions (ZFE4000 / ZSFE4000 Flat)

Workpiece / Condition / Diameter(Ø)	Alloy steel and 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



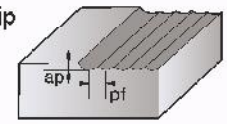
■ Shouldering depth(ap) and radial depth(ae)

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

Application tip

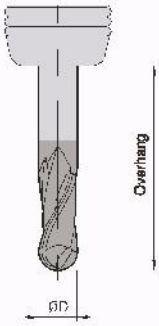


- ap = 0.03D
- pf = 0.05D
- Workpiece should be clamped rigidly. In case of vibration, reduce R.P.M and feed rate by the same ratio

Cutting condition by overhang

■ Cutting conditions of the shank taper type in case of being clamped at neck.
→ When the overhang is increased by 1D, decrease R.P.M and feed 10%.

■ In case of the straight type adjust conditions according to the overhang.
→ Ex) When the overhang is 3D and is increased by 1D, decrease R.P.M and feed 10%.

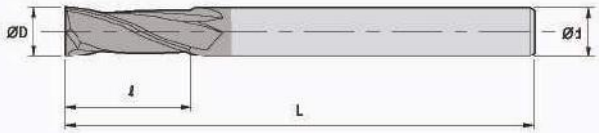


Notice

■ Cutting conditions are up to the machine's condition and the shape of cutting.

■ Use cutting fluid that is proper to the workpiece and produces few temperature reaction.

ZFE2000 (Flat)

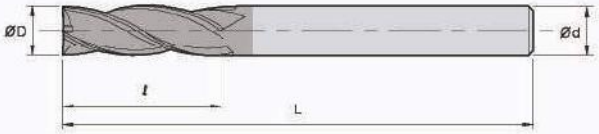


ØD	Tolerance
~Ø5.9	0.00 ~ -0.015
Ø6.0 ~	0.00 ~ -0.025

(mm)

Designation		ØD	Ød	ℓ	L
ZFE	ZFE2010-050-S4	1	4	2.5	50
	ZFE2010-050-S6	1	6	2.5	50
	ZFE2012-050-S4	1.2	4	3	50
	ZFE2012-050-S6	1.2	6	3	50
	ZFE2015-050-S4	1.5	4	4	50
	ZFE2015-050-S6	1.5	6	4	50
	ZFE2020-050-S4	2	4	6	50
	ZFE2020-050-S6	2	6	6	50
	ZFE2025-050-S4	2.5	4	7.5	50
	ZFE2025-050-S6	2.5	6	7.5	50
	ZFE2030-050-S4	3	4	9	50
	ZFE2030-050-S6	3	6	9	50
	ZFE2035-050	3.5	6	10	50
	ZFE2040-050-S4	4	4	11	50
	ZFE2040-050-S6	4	6	11	50
	ZFE2045-050	4.5	6	14	50
	ZFE2050-060	5	6	15	60
	ZFE2055-060	5.5	6	15	60
	ZFE2060-060	6	6	15	60
	ZFE2065-060	6.5	8	18	60
	ZFE2070-060	7	8	20	60
	ZFE2075-060	7.5	8	20	60
	ZFE2080-070	8	8	20	70
	ZFE2085-070	8.5	10	22	70
	ZFE2090-070	9	10	22	70
	ZFE2095-070	9.5	10	24	70
	ZFE2100-075	10	10	25	75
	ZFE2120-080	12	12	30	80
	ZFE2140-100	14	14	35	100
	ZFE2160-100	16	16	40	100

ZFE4000 (Flat)

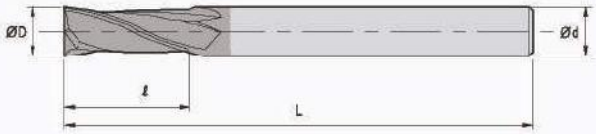


ØD	Tolerance
-~Ø5.9	0.00~-0.015
Ø6.0~	0.00~-0.025

(mm)

	Designation	ØD	Ød	ℓ	L
ZFE	ZFE4010-050-S4	1	4	2.5	50
4	ZFE4010-050-S6	1	6	2.5	50
	ZFE4012-050-S4	1.2	4	3	50
	ZFE4012-050-S6	1.2	6	3	50
	ZFE4015-050-S4	1.5	4	4	50
	ZFE4015-050-S6	1.5	6	4	50
	ZFE4020-050-S4	2	4	6	50
	ZFE4020-050-S6	2	6	6	50
	ZFE4025-050-S4	2.5	4	7.5	50
	ZFE4025-050-S6	2.5	6	7.5	50
	ZFE4030-050-S4	3	4	9	50
	ZFE4030-050-S6	3	6	9	50
	ZFE4035-050	3.5	6	10	50
	ZFE4040-050-S4	4	4	11	50
	ZFE4040-050-S6	4	6	11	50
	ZFE4045-050	4.5	6	12	50
	ZFE4050-060	5	6	15	60
	ZFE4055-060	5.5	6	15	60
	ZFE4060-060	6	6	15	60
	ZFE4065-060	6.5	8	18	60
	ZFE4070-060	7	8	20	60
	ZFE4075-060	7.5	8	20	60
	ZFE4080-070	8	8	20	70
	ZFE4085-070	8.5	10	22	70
	ZFE4090-070	9	10	22	70
	ZFE4095-070	9.5	10	24	70
	ZFE4100-075	10	10	25	75
	ZFE4120-080	12	12	30	80
	ZFE4140-100	14	14	35	100
	ZFE4160-100	16	16	40	100

ZSFE2000 / 4000 (Short Flat)

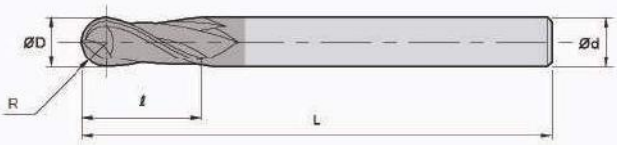


ØD	Tolerance
~ Ø5.9	0.00 ~ -0.015
Ø6.0 ~	0.00 ~ -0.025

(mm)

Designation		ØD	Ød	ℓ	L
ZSFE 2	ZSFE2010-040-S4	1	4	1.5	40
	ZSFE2010-040-S6	1	6	1.5	40
	ZSFE2012-040-S4	1.2	4	1.5	40
	ZSFE2012-040-S6	1.2	6	1.5	40
	ZSFE2015-040-S4	1.5	4	2.2	40
	ZSFE2015-040-S6	1.5	6	2.2	40
	ZSFE2020-040-S4	2	4	3	40
	ZSFE2020-040-S6	2	6	3	40
	ZSFE2025-040-S4	2.5	4	4	40
	ZSFE2025-040-S6	2.5	6	4	40
	ZSFE2030-045-S4	3	4	4.5	45
	ZSFE2030-045-S6	3	6	4.5	45
	ZSFE2040-045-S4	4	4	6	45
	ZSFE2040-045-S6	4	6	6	45
	ZSFE2060-050	6	6	9	50
	ZSFE2080-060	8	8	12	60
	ZSFE2100-065	10	10	15	65
	ZSFE2120-070	12	12	18	70
ZSFE 4	ZSFE4010-040-S4	1	4	1.5	40
	ZSFE4010-040-S6	1	6	1.5	40
	ZSFE4012-040-S4	1.2	4	1.5	40
	ZSFE4012-040-S6	1.2	6	1.5	40
	ZSFE4015-040-S4	1.5	4	2.2	40
	ZSFE4015-040-S6	1.5	6	2.2	40
	ZSFE4020-040-S4	2	4	3	40
	ZSFE4020-040-S6	2	6	3	40
	ZSFE4025-040-S4	2.5	4	4	40
	ZSFE4025-040-S6	2.5	6	4	40
	ZSFE4030-045-S4	3	4	4.5	45
	ZSFE4030-045-S6	3	6	4.5	45
	ZSFE4040-045-S4	4	4	6	45
	ZSFE4040-045-S6	4	6	6	45
	ZSFE4060-050	6	6	9	50
	ZSFE4080-060	8	8	12	60
	ZSFE4100-065	10	10	15	65
	ZSFE4120-070	12	12	18	70

ZBE2000 (Ball)

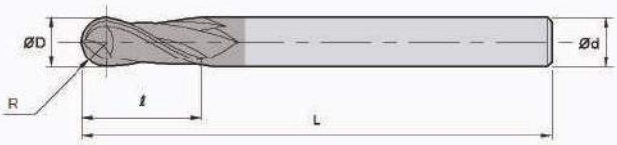


ØD	Tolerance
~ Ø5.9	0.00 ~ -0.015
Ø6.0 ~	0.00 ~ -0.025

(mm)

	Designation	R	ØD	Ød	ℓ	L
ZBE	ZBE2010-050-S4	0.5	1	4	2.5	50
2	ZBE2010-050-S6	0.5	1	6	2.5	50
	ZBE2012-050-S4	0.6	1.2	4	3	50
	ZBE2012-050-S6	0.6	1.2	6	3	50
	ZBE2015-050-S4	0.75	1.5	4	4	50
	ZBE2015-050-S6	0.75	1.5	6	4	50
	ZBE2020-050-S4	1	2	4	5	50
	ZBE2020-050-S6	1	2	6	5	50
	ZBE2025-060-S4	1.25	2.5	4	6	60
	ZBE2025-060-S6	1.25	2.5	6	6	60
	ZBE2030-060-S4	1.5	3	4	8	60
	ZBE2030-060-S6	1.5	3	6	8	60
	ZBE2035-070	1.75	3.5	6	8	70
	ZBE2040-070-S4	2	4	4	8	70
	ZBE2040-070-S6	2	4	6	8	70
	ZBE2045-080	2.25	4.5	6	9	80
	ZBE2050-080	2.5	5	6	10	80
	ZBE2055-090	2.75	5.5	6	11	90
	ZBE2060-090	3	6	6	12	90
	ZBE2065-090	3.25	6.5	8	13	90
	ZBE2070-090	3.5	7	8	14	90
	ZBE2080-100	4	8	8	14	100
	ZBE2085-100	4.25	8.5	10	16	100
	ZBE2090-100	4.5	9	10	18	100
	ZBE2100-100	5	10	10	18	100
	ZBE2120-110	6	12	12	22	110

ZBE2000 (Ball)



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

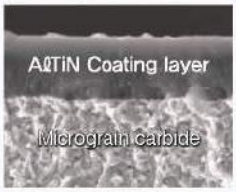
(mm)

	Designation	R	ØD	Ød	ℓ	L
ZBE	ZBE2010-050-S4	0.5	1	4	2.5	50
2	ZBE2010-050-S6	0.5	1	6	2.5	50
	ZBE2012-050-S4	0.6	1.2	4	3	50
	ZBE2012-050-S6	0.6	1.2	6	3	50
	ZBE2015-050-S4	0.75	1.5	4	4	50
	ZBE2015-050-S6	0.75	1.5	6	4	50
	ZBE2020-050-S4	1	2	4	5	50
	ZBE2020-050-S6	1	2	6	5	50
	ZBE2025-060-S4	1.25	2.5	4	6	60
	ZBE2025-060-S6	1.25	2.5	6	6	60
	ZBE2030-060-S4	1.5	3	4	8	60
	ZBE2030-060-S6	1.5	3	6	8	60
	ZBE2035-070	1.75	3.5	6	8	70
	ZBE2040-070-S4	2	4	4	8	70
	ZBE2040-070-S6	2	4	6	8	70
	ZBE2045-080	2.25	4.5	6	9	80
	ZBE2050-080	2.5	5	6	10	80
	ZBE2055-090	2.75	5.5	6	11	90
	ZBE2060-090	3	6	6	12	90
	ZBE2065-090	3.25	6.5	8	13	90
	ZBE2070-090	3.5	7	8	14	90
	ZBE2080-100	4	8	8	14	100
	ZBE2085-100	4.25	8.5	10	16	100
	ZBE2090-100	4.5	9	10	18	100
	ZBE2100-100	5	10	10	18	100
	ZBE2120-110	6	12	12	22	110

Stable performance guaranteed for workpiece which is under HRC45

I⁺ Endmill New

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

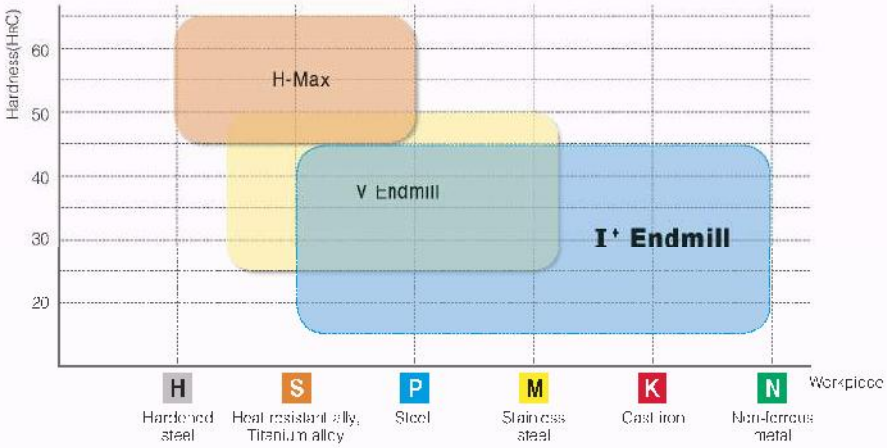


PC320

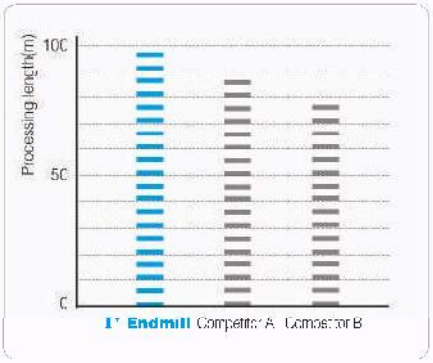
Product line-up

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

Application area



Comparison



I⁺ Endmill | Competitor A | Competitor B

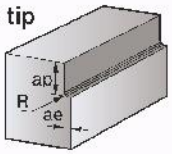
- **Workpiece** : SM45C
- **Curring condition** : Cutting Diameter=Ø8.0 n(min⁻¹)=5173 vc(m/min)=130.0 vf(mm/min)=1034 fz(mm/t)=0.1
  ap(mm)=0.5 ae(mm)=1.6 Dry
- **Tool** : IPBE2080-060

Recommended Cutting Condition (Flat)

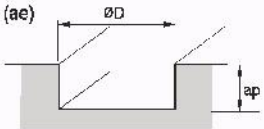
■ IPFE2000

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

● Application tip



■ Shouldering depth (ap) and radial depth (ae)
- ap : <0.1D (D<Ø3)
  ≤0.2D (D>Ø3)
- ae : ≤0.1D (D≤Ø2)
  ≤0.2D (D>Ø2)

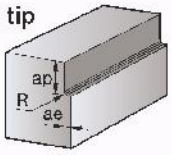


■ Slotting depth(ap)
- ap : <0.1D (D<Ø2)
  ≤0.2D (D>Ø2)

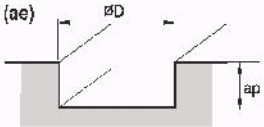
■ IPFE4000

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

● Application tip



■ Shouldering depth (ap) and radial depth (ae)
- ap : ≤1.5D(All diameter)
- ae : ≤0.1D (D≤Ø3)
  ≤0.2D (D>Ø3)



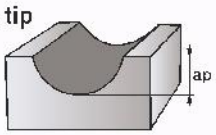
■ Slotting depth(ap)
- ap : ≤0.1D (D≤Ø2)
  ≤0.2D (D>Ø2)

Recommended Cutting Condition (Ball)

■ IPBE2000

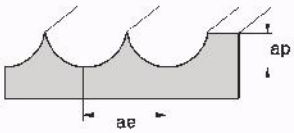
Diameter (ØD)	Carbon steel (SM50C)		Alloy steel (SCM, STD, STS, KP4M, NAK)		Mold steel ~HRC45 (STD61)		Non-ferrous metal (Aluminum)	
	R.P.M (min^{-1})	Feed (mm/min)	R.P.M (min^{-1})	Feed (mm/min)	R.P.M (min^{-1})	Feed (mm/min)	R.P.M (min^{-1})	Feed (mm/min)
1.0	40,000	1,200	38,000	1,200	29,000	900	40,000	1,000
1.5	30,000	1,270	25,500	1,100	19,000	700	40,000	1,360
2.0	24,000	1,160	19,000	800	14,300	600	40,000	2,000
2.5	19,000	1,000	15,300	670	11,500	510	38,000	2,400
3.0	16,000	930	13,000	600	9,600	460	32,000	2,400
3.5	13,700	930	11,400	580	8,200	450	27,300	2,400
4.0	12,000	930	10,000	570	7,200	450	24,000	2,400
5.0	9,600	930	8,000	560	5,700	450	19,000	2,400
6.0	8,000	930	6,400	540	4,800	450	16,000	2,400
8.0	6,000	900	4,800	540	3,600	450	12,000	2,400
10.0	4,800	900	3,800	540	2,900	450	9,600	2,300
12.0	4,000	900	3,200	540	2,400	450	8,000	2,100
14.0	3,400	900	2,750	540	2,050	450	6,800	2,000
16.0	3,000	900	2,400	540	1,800	450	6,000	2,000
20.0	2,400	900	1,900	520	1,450	450	4,800	2,000

● Application tip



■ Slotting depth(ap)

- ap : 0.1×R(~45HRC)
  0.08×R(~50HRC)



(R0.1~0.5=0.2×R)
0.3×R

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

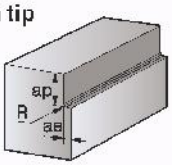
~0.16×R R≤0.3(~45HRC)
~0.25×R R≤3 (~45HRC)
~0.17×R R<4 (~45HRC)
~0.05×R (~50HRC)

Recommended Cutting Condition (Radius)

■ IPRE2000

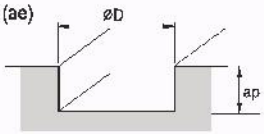
Diameter (ØD)	Carbon steel, Alloy steel ~HRC30 (SM50C, SCM, GC250, Cast iron)			Alloy steel, High speed steel HRC30~45 (Pre hardened steels, STD61, NAK)			Stainless steel (STS304, STS316)		
	R.P.M (min^{-1})	Feed (mm/min)		R.P.M (min^{-1})	Feed (mm/min)		R.P.M (min^{-1})	Feed (mm/min)	
		Shouldering	Slotting		Shouldering	Slotting		Shouldering	Slotting
2.0	11,000	180	180	7,200	110	110	6,000	90	90
3.0	8,500	200	160	5,300	130	100	4,400	110	66
4.0	7,200	360	290	4,400	220	180	3,000	180	110
5.0	6,000	380	300	3,600	230	180	2,400	190	110
6.0	5,300	420	340	3,200	240	190	2,200	210	130
8.0	4,000	450	360	2,400	240	190	1,600	220	130
10.0	3,200	390	310	1,900	190	150	1,300	190	110
12.0	2,700	330	260	1,600	160	130	1,000	150	90

● Application tip



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

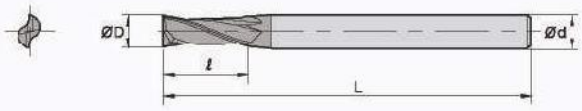
- ap : ≤1.5D
- ap : ≤0.1D



■ Slotting depth(ap)

- ap : ≤0.3D

IPFE2000(Standard Flat)

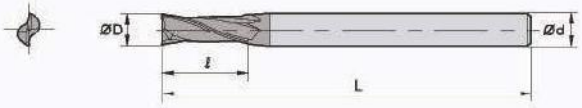


ØD	Tolerance
Ø1~Ø12	0.00 ~ -0.02
Ø12.1~Ø20	0.00 ~ -0.03

(mm)

Designation		ØD	Ød	ℓ	L
IPFE	2010-050-S3	1	3	3	50
2	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)

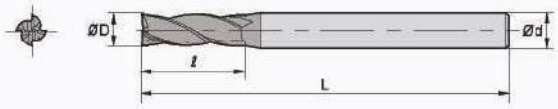
Designation		ØD	Ød	ℓ	L
IPLFE	2060-075	6	6	16	75
	2060-100	6	6	16	100
	2080-075	8	8	20	75
	2080-100	8	8	20	100
	2100-100	10	10	25	100
	2100-150	10	10	25	150
	2120-100	12	12	32	100
	2120-150	12	12	32	150

Long Flute Type

(mm)

Designation		ØD	Ød	ℓ	L
IPLFE	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 (Standard Flat)

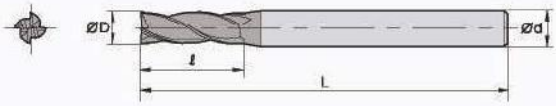


ØD	Tolerance
Ø1~Ø12	0.00 ~ -0.02
Ø12.1~Ø20	0.00 ~ -0.03

(mm)

Designation		ØD	Ød	ℓ	L
IPFE	4010-050-S3	1	3	3	50
4	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)

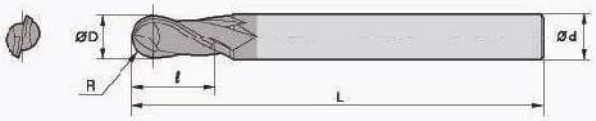
Designation		ØD	Ød	ℓ	L
IPLFE	4060-075	6	6	16	75
4	4060-100	6	6	16	100
	4080-075	8	8	20	75
	4080-100	8	8	20	100
	4100-100	10	10	30	100
	4100-150	10	10	30	150
	4120-100	12	12	32	100
	4120-150	12	12	32	150

Long Flute Type

(mm)

Designation		ØD	Ød	ℓ	L
IPLFE	4010-050-V6S4	1	4	6	50
4	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 (Standard Ball)

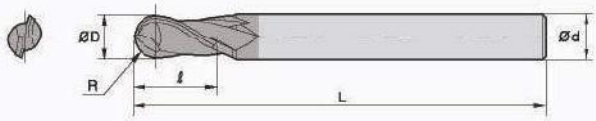


ØD	Tolerance
Ø1~Ø12	0.00 ~ -0.02
Ø12.1~Ø20	0.00 ~ -0.03

(mm)

Designation		R	ØD	Ød	ℓ	L
IPBE	2010-050-S3	0.5	1	3	2	50
2	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	15	28	100
	2160-100	8	16	15	32	100
	2180-100	9	18	20	36	100
	2200-100	10	20	20	40	100

IPLBE2000 (Long Ball)

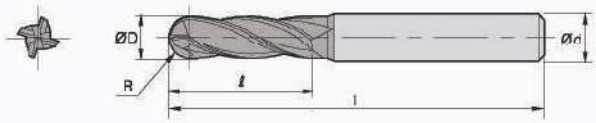


ØD	Tolerance
Ø1~Ø12	0.00 ~ -0.02
Ø12.1~Ø16	0.00 ~ -0.03

(mm)

Designation		R	ØD	Ød	ℓ	L
IPLBE	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 (Standard Ball)

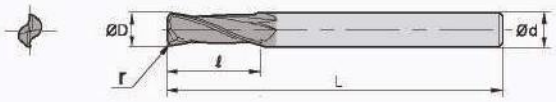


ØD	Tolerance
Ø1~Ø12	0.00 ~ -0.02
Ø12.1~Ø20	0.00 ~ -0.03

(mm)

Designation		R	ØD	Ød	l	L
IPBE	4010-050-S4	0.5	1	4	2	50
4	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 (Standard Radius)

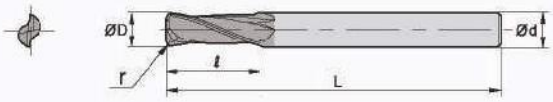


ØD	Tolerance
Ø1~Ø12	0.00~-0.05

(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 (Standard Radius)

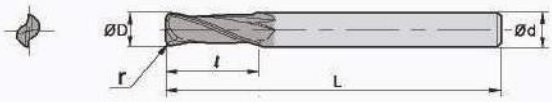


ØD	Tolerance
Ø1~Ø12	0.00 ~ -0.02

(mm)

Designation		ØD	Ød	ℓ	L	r
IPRE	2080-060-R03	8	8	20	60	0.3
2	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)

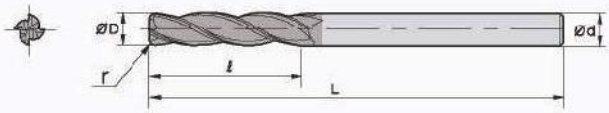


ØD	Tolerance
Ø0~Ø12	0.00~-0.02

(mm)

Designation		ØD	Ød	ℓ	L	r
IPLRE	2030-075-R03	3	3	8	75	0.3
2	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 (Standard Radius)



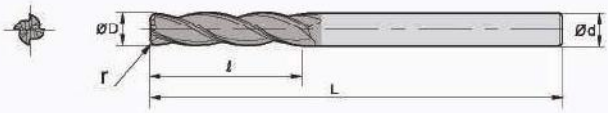
4 | H A 35° | Substrate PC320 | h6 shank

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

IPLRE4000 (Long Radius)



ØD	Tolerance
Ø0~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

High efficiency and high feed in machining

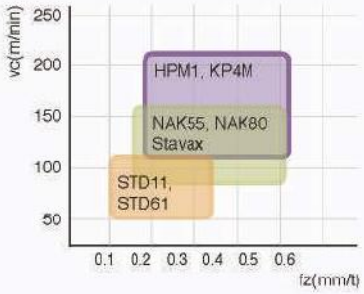
F Endmill

Feed-up Endmill

Feature

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

■ Application by workpiece



Productivity example

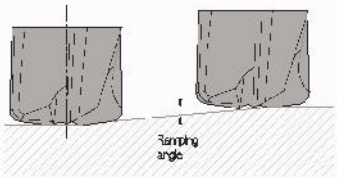
■ Productivity comparison

Type	Speed (vc)	Feed (fz)	D.O.C		Machining volume (mm³/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**

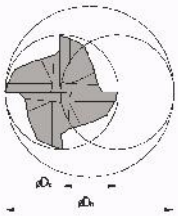
Programing information

■ Ramping



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

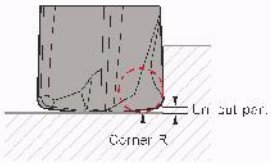
■ Helical ramping



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

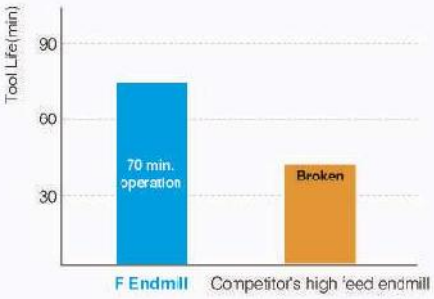
*ØDc : Feed(Tool center)
*ØDh : Machining area

■ CAM program information



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

Machining example

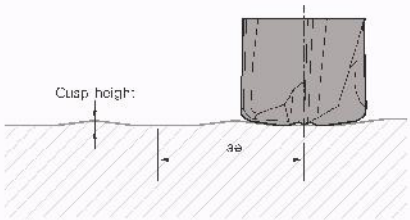


- **Workpiece** STD61+SKT4(HRC 45~50)
- **Cutting condition** D=Ø12, n(min⁻¹)=4,000, vc(m/min)=150.8, vf(mm/min)=4,000, fz(mm/t)=0.25 , ap(mm)=3.6, ae(mm)=6.0, Dry
- **Tools** FME4120-075-R12

Cutting condition

■ Cusp height by radial depth of cut

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



■ Medium cut

Diameter (ØD)	Mold steel HRC35~45(HPM1, KP4M)				Mold steel HRC45~55(NAK55, NAK80, STAVAX)				Heat treated HRC55(SKD11, STD61)			
	RPM n(min⁻¹)	Feed (mm/min)	ap(mm)	ae(mm)	RPM n(min⁻¹)	Feed (mm/min)	ap(mm)	ae(mm)	RPM n(min⁻¹)	Feed (mm/min)	ap(mm)	ae(mm)
6	11,600	11,200	0.24	1.6	9,000	7,570	0.21	1.6	5,800	3,500	0.18	1.6
8	8,700		0.32	2.2	6,700		0.28	2.2	4,300		0.24	2.2
10	7,000		0.40	2.7	5,400		0.35	2.7	3,500		0.30	2.7
12	5,800		0.48	3.3	4,500		0.42	3.3	2,900		0.36	3.3

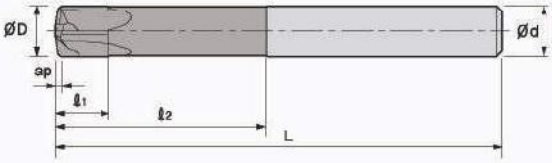
■ Roughing cut

Diameter (ØD)	Mold steel HRC35~45(HPM1, KP4M)				Mold steel HRC45~55(NAK55, NAK80, STAVAX)				Heat treated HRC55(SKD11, STD61)			
	RPM n(min⁻¹)	Feed (mm/min)	ap(mm)	ae(mm)	RPM n(min⁻¹)	Feed (mm/min)	ap(mm)	ae(mm)	RPM n(min⁻¹)	Feed (mm/min)	ap(mm)	ae(mm)
6	8,488	9,167	0.27	3.0	6,366	6,112	0.24	3.0	4,244	2,546	0.21	3.0
8	6,366		0.36	4.0	4,775		0.32	4.0	3,183		0.28	4.0
10	5,093		0.45	5.0	3,820		0.40	5.0	2,546		0.35	5.0
12	4,244		0.54	6.0	3,183		0.48	6.0	2,122		0.42	6.0

* Cutting condition by overhang

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

FME4000 (Standard)

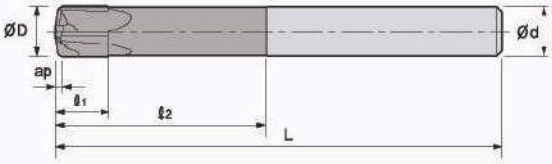


ØD	Tolerance
Ø6~Ø12	- 0.01 ~ - 0.03

(mm)

	Designation	R	ØD	Ød	ℓ1	ℓ2	L	Max. ap (mm)	CAM-Radius
FME	4060-050-R05	0.5	6	6	4.5	18	50	0.35	0.7
4	4080-060-R05	0.5	8	8	6	24	60	0.45	0.8
	4100-070-R10	1.0	10	10	7.5	30	70	0.65	1.3
	4120-075-R12	1.2	12	12	9	36	75	0.78	1.6

FMLE4000 (Long)



ØD	Tolerance
Ø6~Ø12	- 0.01 ~ - 0.03

(mm)

	Designation	R	ØD	Ød	ℓ1	ℓ2	L	Max. ap (mm)	CAM-Radius
FMLE	4060-090-R05	0.5	6	6	4.5	30	90	0.35	0.7
4	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

Ideal Endmill for ultra precision geometry machining

Micro Endmills

- Enhanced rigidity of neck eliminates braking of the tool
- It is ideal for ultra precision geometry machining
- Slotting, Die-sinking, Profiling, Miniature, Finishing
- Camera, Watch, Precision mold

※ Notice

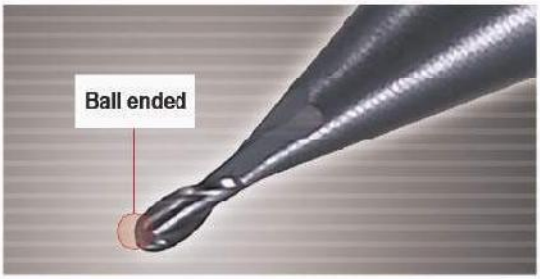
Users should operate high precision machine and clamp tool with its' best rigidity and accuracy
Anti vibration system is required for stable cutting. Watch operation for chip evacuation

Micro Endmills Code System

MS	E	2	004	-	S
Solid Endmill	Type	No. of edge	Diameter		Shank diameter
Micro Solid	E : Flat BE : Ball	2 Edges	Ø0.4		S : Ø3.0mm No code : Ø4.0mm (Diameter Ø2, Ø3) Ø6.0mm (Others)

Product shape

MSBE



MSE

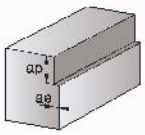
Recommended Cutting Condition - MSE2000

Workpiece / Condition / Diameter(Ø)	Carbon steel, Alloy steel, Cast iron			Alloy steel, High speed steel		
	HRC45 ~			HRC45~55		
	SM50C,SCM,STD			STD61,STAVAX		
	R.P.M n(min⁻¹)	Feed vf(mm/min)	Radial depth ae(mm)	R.P.M n(min⁻¹)	Feed vf(mm/min)	Radial depth ae(mm)
0.4	40,000	640	0.01	40,000	640	0.01
0.5	40,000	800	0.02	40,000	800	0.015
0.6	40,000	960	0.02	40,000	960	0.02
0.7	40,000	1,120	0.02	40,000	1,120	0.02
0.8	40,000	1,280	0.03	40,000	1,280	0.03
0.9	40,000	1,440	0.04	40,000	1,280	0.04
1.0	40,000	1,600	0.06	40,000	1,280	0.06

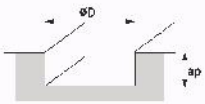
- Workpiece should be clamped rigidly In case of vibration, reduce RPM and feed rate by the same ratio

1. Workpiece should be clamped rigidly. In case of vibration, reduce RPM and feed rate by the same ratio
2. In case of shouldering, reduce feed rate to 1/3

Application tip

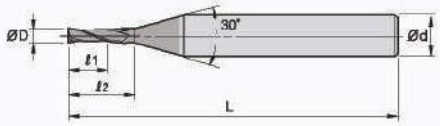


- ap<ae



- D≥3 : increase RPM 50~70%
  reduce feed rate 40~60%
- Slotting : ap≤ae

MSE2000 (Flat)

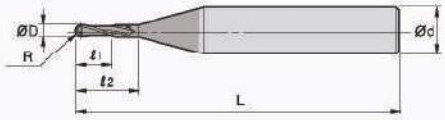


ØD	Tolerance
Ø0.2~Ø1.0	0 ~ -0.02

(mm)

Designation		ØD	Ød	ℓ1	ℓ2	L
MSE	2002	0.2	4	0.4	0.6	40
	2003	0.3	4	0.6	0.9	40
	2004	0.4	6	0.8	1.2	50
	2004-S	0.4	3	0.8	1.2	45
	2005	0.5	6	1	1.5	50
	2005-S	0.5	3	1	1.5	45
	2006	0.6	6	1.2	1.8	50
	2006-S	0.6	3	1.2	1.8	45
	2007	0.7	6	1.4	2.1	50
	2007-S	0.7	3	1.4	2.1	45
	2008	0.8	6	1.6	2.4	50
	2008-S	0.8	3	1.6	2.4	45
	2009	0.9	6	1.8	2.7	50
	2009-S	0.9	3	1.8	2.7	45
	2010	1	6	2	3	50
	2010-S	1	3	2	3	45

MSBE2000 (Ball)



ØD	Tolerance
Ø0.2~Ø1.0	0 ~ -0.02

(mm)

Designation		R	ØD	Ød	ℓ1	ℓ2	L
MSBE	2002	0.1	0.2	4	0.2	0.4	40
	2003	0.15	0.3	4	0.3	0.6	40
	2004	0.2	0.4	6	0.8	1.2	50
	2004-S	0.2	0.4	3	0.8	1.2	45
	2005	0.25	0.5	6	1	1.5	50
	2005-S	0.25	0.5	3	1	1.5	45
	2006	0.3	0.6	6	1.2	1.8	50
	2006-S	0.3	0.6	3	1.2	1.8	45
	2007	0.35	0.7	6	1.4	2.1	50
	2007-S	0.35	0.7	3	1.4	2.1	45
	2008	0.4	0.8	6	1.6	2.4	50
	2008-S	0.4	0.8	3	1.6	2.4	45
	2009	0.45	0.9	6	1.8	2.7	50
	2009-S	0.45	0.9	3	1.8	2.7	45
	2010	0.5	1	6	2	3	50
	2010-S	0.5	1	3	2	3	45

Special endmills order - MSE : MSE20@@l-L / MSBE : MSBE20@@l-L

EX.1) Diameter : 0.45, l : 1.2, L : 55 MSE20045 1.2-55L

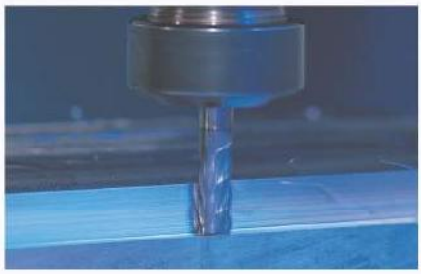
Ex.2) Ball R0.225(Ø0.45), l : 1.2, L : 55 MSBE0045 1.2-55L

The diameter should be smaller than Ø1.0 for MSE, MSBE. In case of above Ø1.0, please refer to SSE-Q and SSBE-Q.

Optimal design for stainless steel machining

Solid Endmills for Hard-to-cut material

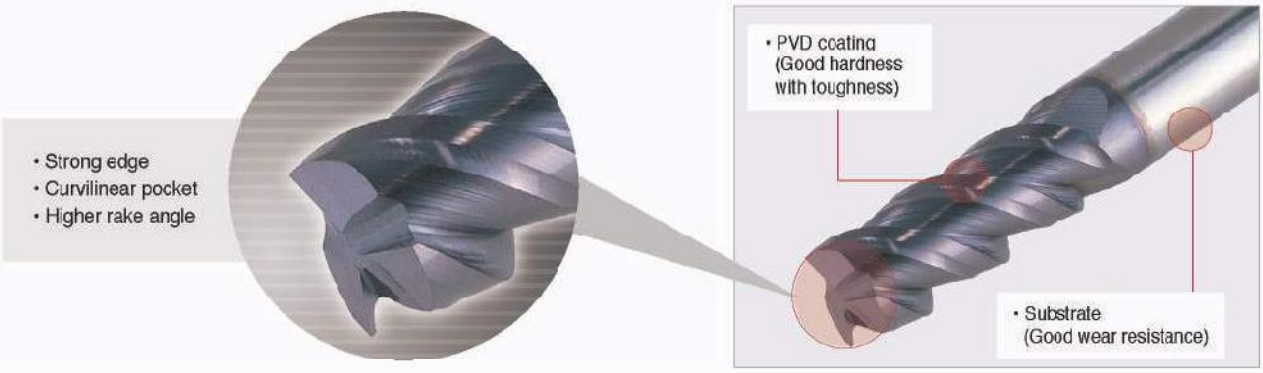
- High rake angle and curvilinear designed pocket for improved chip evacuation.
- Special edge for work hardening
- Optimized for stainless steel machining (Stainless steel, Titanium alloy, Inconel, Steel, Alloy steel)
- Multi applications (Shouldering, Slotting, Ramping)



Endmills for Hard-to-cut materials Code System

I	FS	E	3	030 - 045
Coating	Flat solid	Endmill	No. of edges 3 Edge	Diameter Ø3.0	Tool length 45mm

Product shape



Trouble shooting for Stainless steel machining

Stainless steel machining Work hardening	Stainless steel machining Trouble shooting
• Poor surface finish • High temperature on cutting edge • Built-up edge • Shear strength in high temperature • Difficult chip breaking and controlling	• Low cutting speed • Sharp cutting edge • Coolant for low temperature • Air blow or coolant for better chip evacuation • Higher harness of substrates and coating

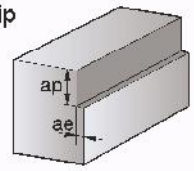
Comparison Stainless steel to Carbon steel

Classifications		KS grade	Tensile strength (kgf/mm²)	Thermal expansion coefficient (10^{-6}/℃)	Thermal expansion Rate (10^{-2}cal/cm.s.℃)	Magnetic	Annealing hardening	Hardness (HB)	Machine Ability rate (%)
Carbon steel		SS34 SS41 SM10C SM15C	38~65	11.4	11.2	○	○	110~180	50~70
Stainless steel	Martensite series	STS403 STS410 STS431	~55	9.9~11.7	5.9	○	○	215	50~60
Stainless steel	Ferrite series	STS405 STS430	50~60	10.4	6.4	○	×	183	50~60
Stainless steel	Austenite series	STS301 STS304 STS316	55~65	14.4~16.9	3.8	×	×	187	35~45

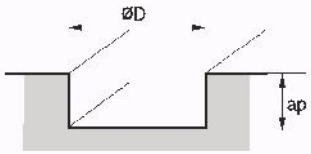
Recommended Cutting Condition

Workpiece / Condition / Diameter(Ø)	Stainless steel STS		Titanium alloy / Inconel		Normal steel (SS, SM) (Under HRC25)		Alloy steel (SCM) (HRC25~35)		Hardened steel (STD) (HRC40~50)	
	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)
2	5,500	240	2,600	90	9,000	540	6,000	320	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

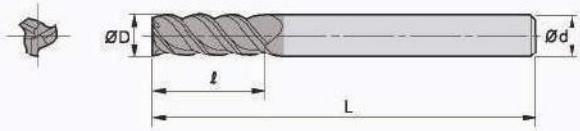


■ Shouldering depth (ap) and radial depth (ae)
- Normal steel, Alloy steel, Stainless steel
- Titanium alloy, Inconel, Hardened steel



■ Slotting depth(ap)
- Normal steel, Alloy steel
- Stainless steel
- Titanium alloy, Inconel, Hardened steel

IFSE3000 (Flat)



H·A 50°

TIAIN

Substrate PC210

ØD	Tolerance
Ø1 ~Ø 6	- 0.01 ~ - 0.030
Ø7 ~ Ø10	- 0.015 ~ - 0.040
Ø11 ~Ø 20	- 0.020 ~ - 0.050

(mm)

Designation		ØD	Ød	ℓ	L
IFSE	3030-045	3	6	10	45
	3035-045	3.5	6	10	45
	3040-045	4	6	12	45
	3045-045	4.5	6	12	45
	3050-050	5	6	15	50
	3055-050	5.5	6	15	50
	3060-050	6	6	15	50
	3065-060	6.5	8	20	60
	3070-060	7	8	20	60
	3075-060	7.5	8	20	60
	3080-060	8	8	20	60
	3085-070	8.5	10	20	70
	3090-070	9	10	20	70
	3095-070	9.5	10	20	70
	3100-070	10	10	25	70
	3110-075	11	12	25	75
	3120-075	12	12	30	75
	3130-090	13	16	30	90
	3140-090	14	16	35	90
	3150-090	15	16	40	90
	3160-090	16	16	40	90
	3170-100	17	20	40	100
	3180-100	18	20	45	100
	3190-110	19	20	45	110
	3200-110	20	20	45	110

IFSE3❍❍❍-L-l(V00)

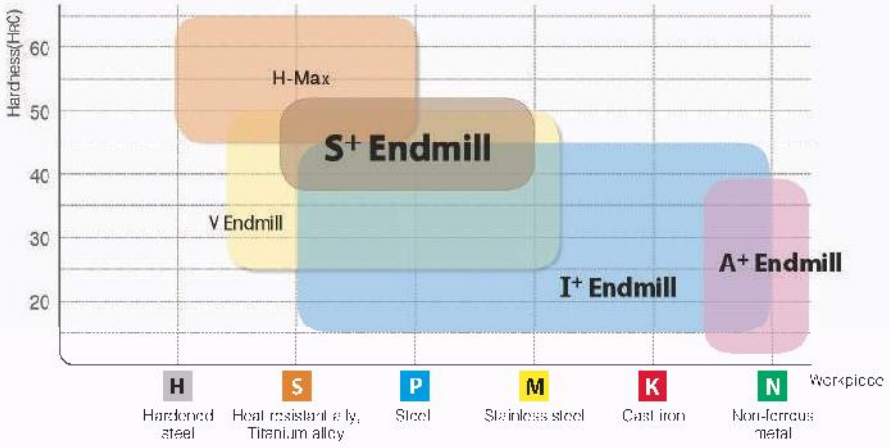
Ex.1) 3 flutes, diamater : 6.3.l : 17, _ : 60 - IFSE3063-060-V17

Stainless Endmill Series

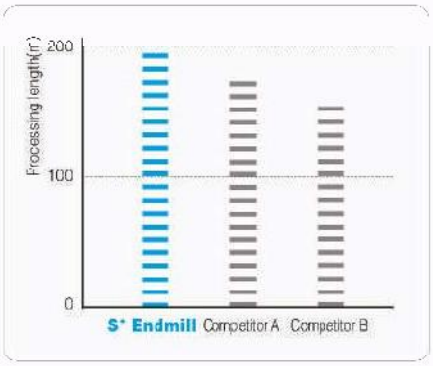
S+ Endmill New

- 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



Comparison



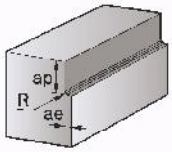
S+ Endmill | Competitor A | Competitor B

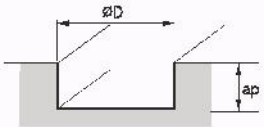
- **Workpiece** : STS304
- **Curring condition** : diameter=Ø8.0, n(min⁻¹)=4000, vc(m/min)=100, vf(mm/min)=480, fz(mm/t)=0.04
  ap(mm)=8, ae(mm)=0.8, dry
- **Tool** : SPFE4080-060

Recommend Cutting Conditions

Workpiece / Condition / Diameter(Ø)	Stainless steel STS		Titanium alloy / Inconel		Normal steel(SS, SM) (Under HRC 25)		Alloy steel(SCM) (HRC 25~35)		Hardened steel(STD) (HRC 40~50)	
	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)	R.P.M n(min⁻¹)	Feed vf(mm/min)
2	5,500	240	2,600	90	9,000	540	6,000	320	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
  - Titanium alloy, Inconel, Hardened steel

- **Slotting depth(ap)**
  - Normal steel, Alloy steel
  - Stainless steel
  - Titanium alloy, Inconel, Hardened steel

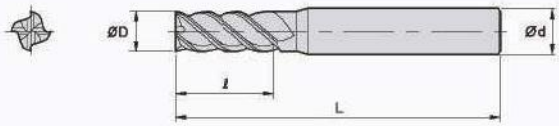
Stainless steel machining

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

Trouble shooting for stainless steel

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

SPFE4000 (Standard Flat)



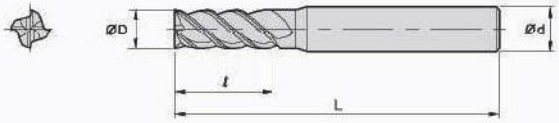
4 | H·A 45° | Substrate PC325 | h6 shank

ØD	Tolerance
Ø1~Ø12	0.00 ~ -0.02

(mm)

Designation		ØD	Ød	ℓ	L
SPFE 4	4010-050	1.0	4	3	50
	4015-050	1.5	4	4	50
	4020-050	2.0	4	5	50
	4025-050	2.5	4	8	50
	4030-050	3.0	4	9	50
	4030-050-S6	3.0	6	9	50
	4040-050	4.0	4	11	50
	4040-050-S6	4.0	6	11	50
	4050-050	5.0	6	13	50
	4060-050	6.0	6	16	50
	4080-060	8.0	8	20	60
	4100-075	10.0	10	30	75
	4120-075	12.0	12	32	75

SPLFE4000 (Long Flat)



4 | H·A 45° | Substrate PC325 | h6 shank

ØD	Tolerance
Ø1~Ø12	0.00 ~ -0.02

(mm)

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

Good chip evacuation

Solid Endmills for Aluminum

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

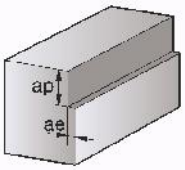
Endmills for Aluminum Code System

SSE	A	2	-	010
Solid endmill	Application	No. of edges		Diameter
	For Aluminum	2 : 2 Edge 3 : 3 Edge		Ø1.0

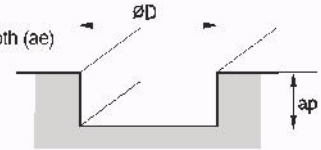
Recommended Cutting Condition (SSEA2000)

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

Application tip



■ Shouldering depth (ap) and radial depth (ae)
- ae≤0.2D(D<3)
- ae≤0.5D(D≥3)



■ Slotting depth(ap)
- ap≤D(max:12mm)

* Workpiece should be clamped rigidly in case of vibration, reduce RPM and feed rate by the same ratio

Copper & Aluminum machining

1. Built-up edge
2. Low heat resistance could create unnessary stress or accuracy problem after machining
3. Scratch due to low hardness
4. Low tool life due to flank wear

Trouble shooting for Copper & Aluminum machining

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

SSEA2000 / 3000 (Flat)

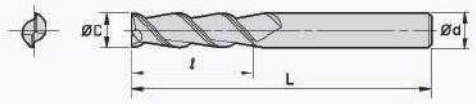


Fig. 1

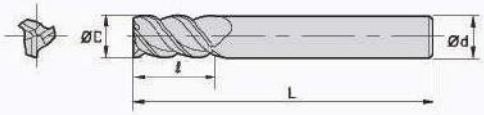


Fig. 2

H·A 45°

Carbide DLC

Substrae HN1 PD3000

ØD	Tolerance
Ø1 ~Ø 6	- 0.010 ~ - 0.030
Ø7 ~ Ø10	- 0.015 ~ - 0.040
Ø11 ~Ø 20	- 0.020 ~ - 0.050

(mm)

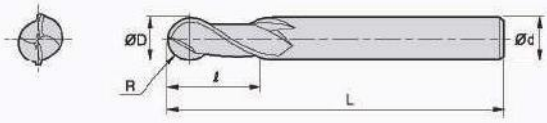
Designation		ØD	Ød	ℓ	L	Fig.
SSEA	2010	1	6	3	40	1
	2015	1.5	6	4	40	1
	2020	2	6	6	40	1
	2025	2.5	6	7	40	1
	2030	3	6	10	45	1
	2035	3.5	6	10	45	1
	2040	4	6	12	45	1
	2050	5	6	15	50	1
	2060	6	6	15	50	1
	2070	7	8	20	60	1
	2080	8	8	20	60	1
	2090	9	10	20	70	1
	2100	10	10	25	70	1
	2110	11	12	25	75	1
	2120	12	12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

Special endmills orcer : SSEA②③③③I-L

Ex.1) 3 f utes, diameter : 6.3.l:17, L : 60 SSEA3063 17-60L

Ex.2) 3 f utes, 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 : SSBEA2◎◎◎I-L
Ex.1) 2 flutes, diameter : 3.3, l :17, L : 60 SSBEA3063 17-60L
Ex.2) 2 flutes, diameter : 3.3, standard type SSBEA3063

• Technique of machining Copper/Aluminum steel

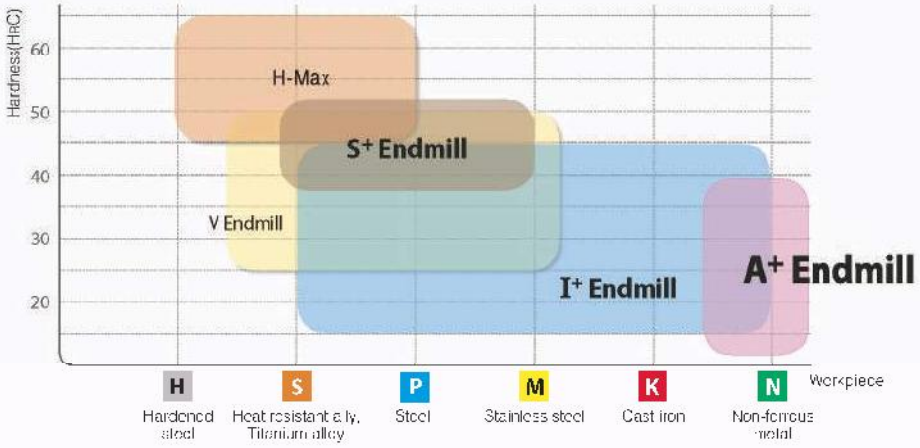
1. With high rake angle cutting edge, sharp tools and oil mist, able to minimize cutting load and built-up-edge
2. Applying higher cutting speed and shallower depth, able to make surface finishing and productivity improved

Aluminum Endmill Series

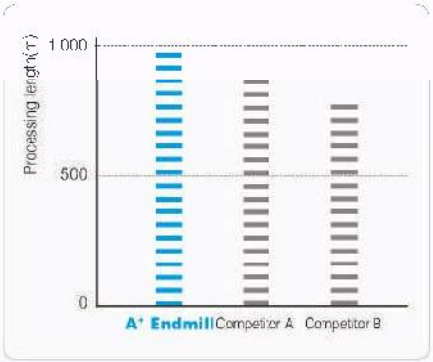
A+ Endmill New

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

Application area



Comparison



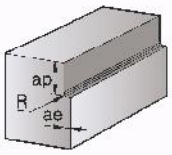
A+ Endmill | Competitor A | Competitor B

- **Workpiece** : A7075
- **Curring condition** : diameter=Ø8.0, n(min^{-1})=8000, vc(m/min)=200, vf(mm/min)=1200, fz(mm/t)=0.05
  ap(mm)=8, ae(mm)=2.0, wet
- **Tool** : APFE3080-060

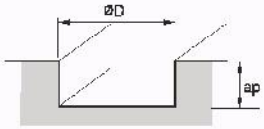
Recommend Cutting Conditions

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

Application tip



■ Shouldering depth (ap) and radial depth (ae)
- ae≤0.2D(D<3)
- ae≤0.5D(D≥3)



■ Slotting depth(ap)
- ae≤0.2D(D<3)
- ae≤0.5D(D≥3)

• Clamp the workpiece rigidly. In case of vibration, reduce RPM and feed rate by the same ratio.

Aluminum machining

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

Trouble shooting for Aluminum machining

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

APFE2000 / 3000 (Flat) Standard

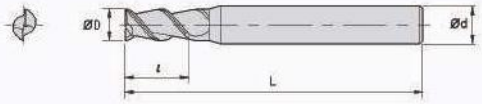


Fig. 1

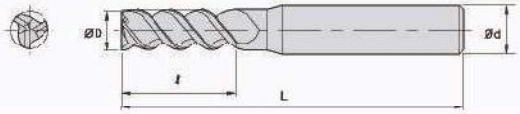


Fig. 2

2 | 3 | H·A 50° | Substrate HOSS | h6 shank

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

(mm)

Designation		ØD	Ød	ℓ	L	Fig.
APFE 2	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
APFE 3	3025-050	2.5	6	8	50	2
	3030-050	3.0	6	9	50	2
	3040-050	4.0	6	12	50	2
	3050-050	5.0	6	15	50	2
	3060-050	6.0	6	18	50	2
	3080-060	8.0	8	20	60	2
	3100-075	10.0	10	30	75	2
	3120-075	12.0	12	32	75	2
	3160-100	16.0	16	45	100	2
	3200-100	20.0	20	45	100	2

APLFE2000 / 3000 (Long Flat)

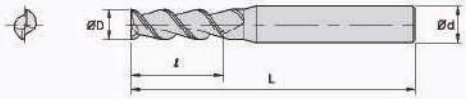


Fig. 1

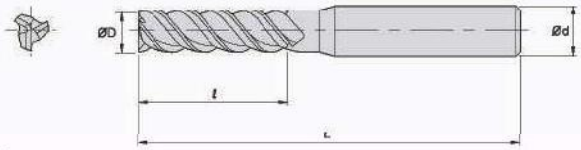


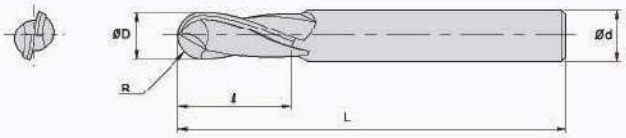
Fig. 2

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

(mm)

Designation		ØD	Ød	ℓ	L	Fig.
APLFE	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	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) Standard



H·A 25°

Substrate H05S

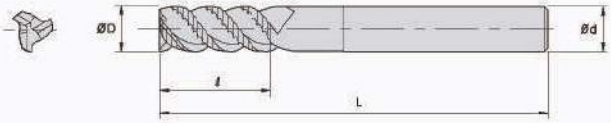
h6 shank

ØD	Tolerance
Ø1~Ø12	0.00 ~ -0.02

(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

APRE3000 (Roughing)



H·A 45°

Substrate H05S

h6 shank

ØD	Tolerance
Ø1~Ø12	0.00 ~ -0.02

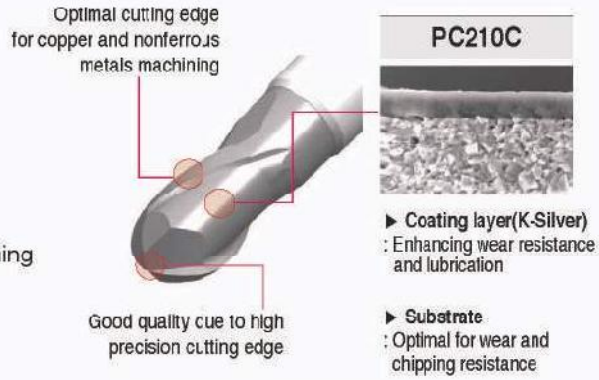
(mm)

Designation		ØD	Ød	ℓ	L
APRE	3040-050	4.0	6	13	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

Long tool life and good surface roughness for electrode machining

C-Max
(Copper)

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



Machining example

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

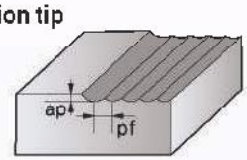
- **Test result**

CRE | Competitor A | Competitor B

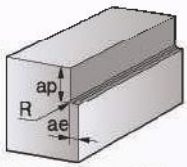
Recommended Cutting Condition

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

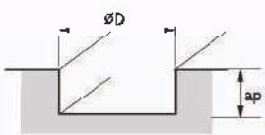
Application tip



• ap=0.1D , pf=0.2D



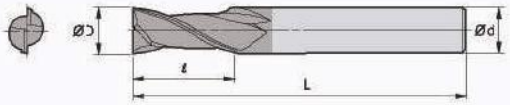
• ap=1.5D , ae=0.1D



• ap≤1.5D

• If vibration occurs, please reduce R.P.M and feed rate at the same rate

CFE2000 (Flat)

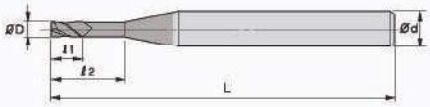


ØD	Tolerance
Ø0.5~Ø6	0 ~ 0.01
Ø8~Ø12	0 ~ 0.02

(mm)

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

CFNE2000 (Long Neck Flat)

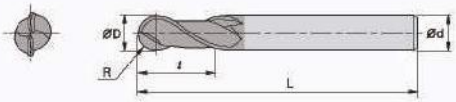


ØD	Tolerance
Ø0.5~Ø6	0 ~ 0.01
Ø8~Ø12	0 ~ 0.02

(mm)

	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
	2020-050-N12	2	4	3	12	50
	2030-050-N10	3	4	4.5	10	50
	2030-050-N12	3	4	4.5	12	50
	2030-060-N14	3	4	4.5	14	60
	2030-060-N16	3	4	4.5	16	60
	2040-050-N12	4	6	6	12	50
	2040-050-N16	4	6	6	16	50
	2040-060-N20	4	6	6	20	60

CBE2000 (Ball)



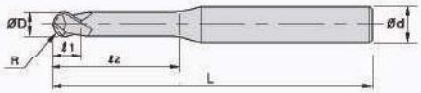
H·A 30°
CrN
Substrate PC210C

ØD	Tolerance	R Tolerance
Ø0.5~Ø6	0 ~ 0.01	±0.005
Ø8~Ø12	0 ~ 0.02	±0.005

(mm)

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

CBNE2000 (Long Neck Ball)



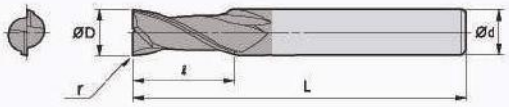
H·A 30°
CrN
Substrate PC210C

ØD	Tolerance
Ø0.5~Ø6	0 ~ 0.01
Ø8~Ø12	0 ~ 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	55
	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)

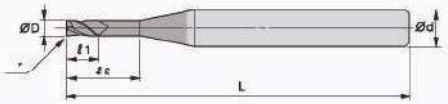


ØD	Tolerance	R Tolerance
Ø0.5~Ø6	0 ~ 0.01	±0.005
Ø8~Ø12	0 ~ 0.02	±0.005

(mm)

	Designation	r	ØD	Ød	ℓ	L
CRE	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 ~ 0.01	±0.005
Ø8~Ø12	0 ~ 0.02	±0.005

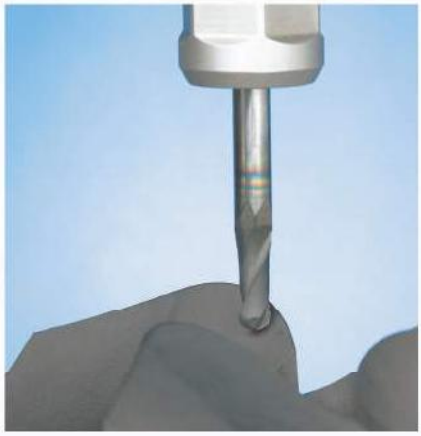
(mm)

	Designation	r	ØD	Ød	ℓ_1	ℓ_2	L
CRNE	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
	2020-050-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

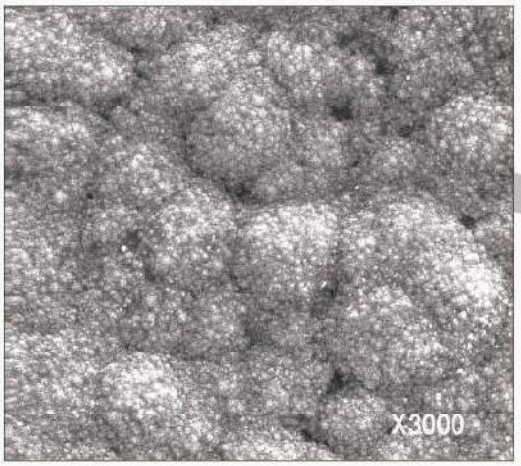
Unique diamond coating technology

D-Max

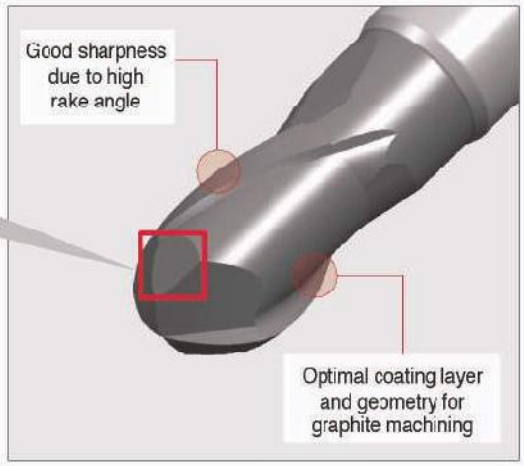
- Unique diamond coating technology
- Good surface roughness through improved endmill geometry and ultra fine substrate
- Wide cutting area from intermittent cutting to high precision cutting
- 10~20 times longer tool life than uncoated carbide endmill



Coating and Endmill geometry



ND3000 Coated

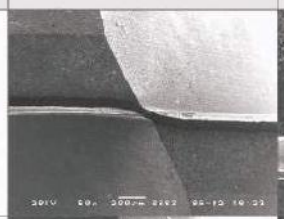
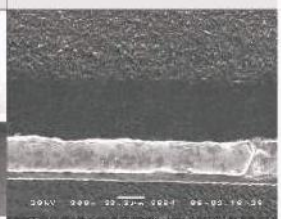
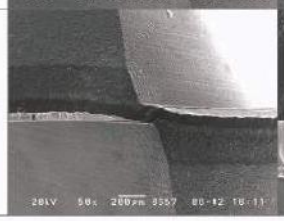
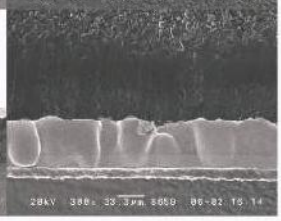


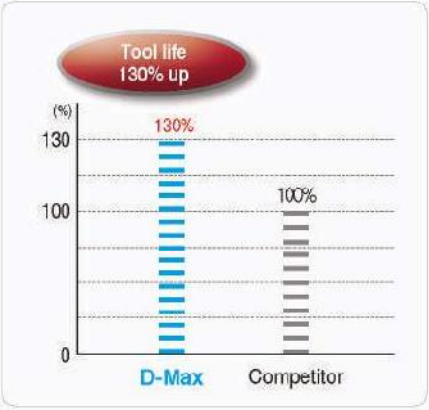
Machining example

• **Test result**

Workpiece: graphite

Cutting condition : **n**=16,000(mim^{-1}) **vf**=2,6000(mm/min) **ap**=1.5mm **ae**=0.6mm

	Wear	Detail Wear
D-Max		
Competitor		



Recommended Cutting Condition (DFE2000 Flat)

Workpiece / Condition / Diameter(Ø)	Graphite		Aluminum alloys		Copper alloys	
	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	21,000	1,280	21,000	670	21,000	640
4	16,000	1,180	16,000	670	16,000	640
6	10,500	1,180	10,500	670	10,500	560
8	8,000	1,080	8,000	600	8,000	540

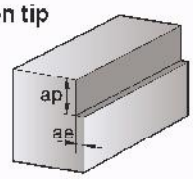
Recommended Cutting Condition (DBE2000 Ball)

Workpiece / Condition / Diameter(Ø)	Graphite		Aluminum alloys		Copper alloys	
	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)
4	15,000	1,900	15,900	1,550	11,900	1,150
6	15,000	1,900	10,500	1,550	7,950	1,150
8	13,900	1,900	7,950	1,550	5,950	1,150

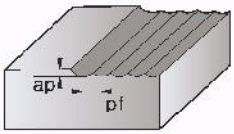
Recommended Cutting Condition (DRE2000 Radius)

Workpiece / Condition / Diameter(Ø)	Graphite		Aluminum alloys		Copper alloys	
	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)
4	13,990	1,180	15,900	670	11,990	640
6	13,900	1,180	10,500	670	7,950	560
8	10,000	1,080	7,950	600	5,950	540

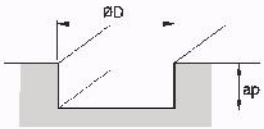
- Application tip



- Graphite
  ap=1.5D, ae=0.1D
- Aluminum alloys
  ap=1.5D, pf=0.1D
- Copper alloys
  ap=1.5D, pf=0.1D

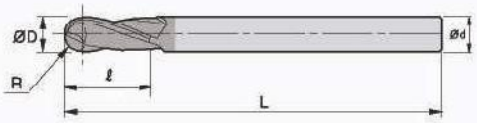


- Graphite
  ap=0.5D, pf=0.1D
- Aluminum alloys
  ap=0.5D, pf=0.1D
- Copper alloys
  ap=0.5D, pf=0.1D



- Graphite
  ap=0.1D
- Aluminum alloys
  ap=0.1D
- Copper alloys
  ap=0.1D

DBE2000 (Ball)

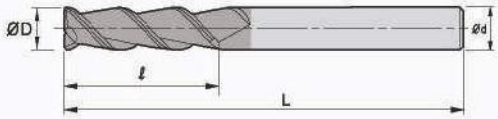


2 | H·A 30° | Dia | Substrate ND3000

(mm)

	Designation	R	ØD	Ød	ℓ	L
DBE	2040-070	2	4	6	12	70
2	2060-080	3	6	6	15	80
	2080-090	4	8	8	20	90

DFE2000 (Flat)

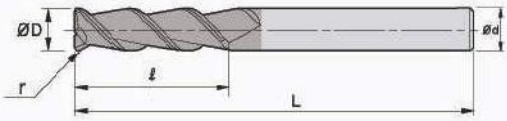


2 | H·A 30° | Dia | Substrate ND3000

(mm)

	Designation	ØD	Ød	ℓ	L
DFE	2030-045	3	6	10	45
2	2040-045	4	6	12	45
	2060-050	6	6	15	50
	2080-060	8	8	20	60

DRE2000 (Radius)



2 | H·A 30° | Dia | Substrate ND3000

(mm)

	Designation	r	ØD	Ød	ℓ	L
DRE	2040-045-R05	0.5	4	6	5	45
2	2060-050-R05	0.5	6	6	7	50
	2080-060-R10	1	8	8	9	60

Longer tool life and good surface finishes

PCD Endmills

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

PCD Endmill Code System

PDE	2	080
Endmill	No. of Flute	Diameter
PDE : PCD Endmill	2 Flutes	Ø8.0

Recommended Cutting Condition

Work piece	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

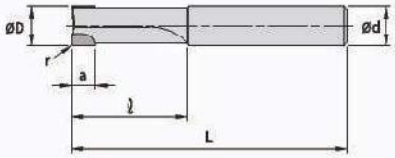


Fig.1

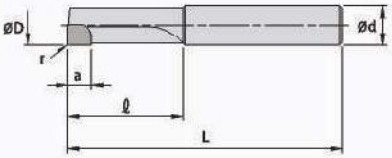
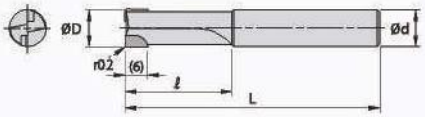


Fig.2

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	1040	4	6	15	45
1	1050	5	6	15	50
	1060	6	6	20	60
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

High precision machining with our high stiffness design

Brazed Endmills

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

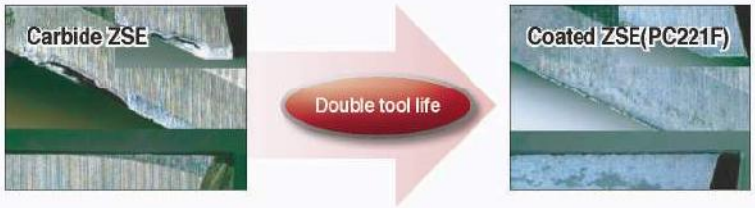
PC221F Coating

New PVD films
New hardness and oxidation resistance coating

Brazed Endmills Code System

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

Wear resistance test (W.P:STD61)



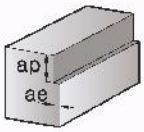
Recommended Cutting Condition (ZSE200 Flat)

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

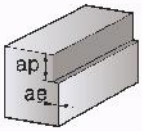
Recommended Cutting Condition (ZSE400 Flat)

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

- **Application tip**



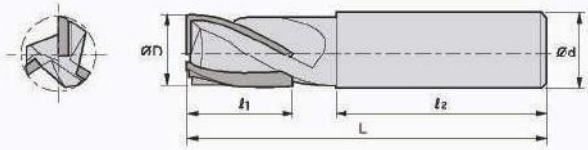
■ Side milling (under HRC45)
· ap≤1.5D · ae≤0.1D



■ Side milling (over HRC45)
· ap≤1D(Max : 1mm)

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

ZSE200 / 300 (Flat)



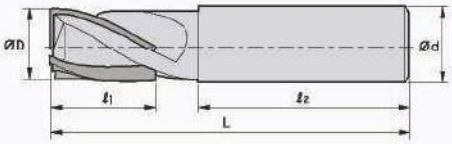
OD	Tolerance
All	0 ~ - 0.050

(mm)

Designation		ØD	Ød	ℓ1	ℓ2	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)



Carbide

Substrate: RCC / PGZZ IF

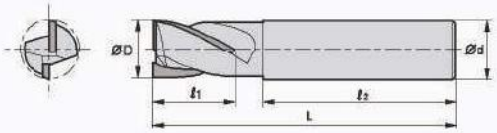
OD	Tolerance
All	0 ~ - 0.050

(mm)

	Designation	ØD	Ød	ℓ1	ℓ2	L
ZSE	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	60	160
	345S	45	42	65	60	160
	350	50	32	65	60	160
	350S	50	42	65	60	160
ZSE	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	60	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	60	160
	445S	45	42	65	60	160
	450	50	32	65	60	160
	450S	50	42	65	60	160
ZSE	634	34	32	50	85	150
	635	35	32	50	85	150
	638	38	32	55	60	150
	638S	38	42	55	60	150
	640	40	32	60	75	150
	640S	40	42	60	75	150
	645	45	32	65	60	160
	645S	45	42	65	60	160
	650	50	32	65	60	160
	650S	50	42	65	60	160

Special Endmills order : ZSE@@@@l-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)

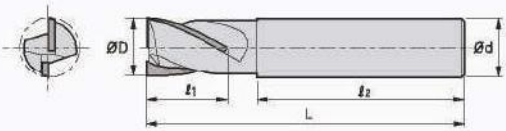


ØD	Tolerance
All	0 ~ - 0.050

(mm)

Designation		ØD	Ød	ℓ1	ℓ2	L
ZSEA	215	15	16	28	57	95
	216	16	16	28	55	95
	218	18	20	30	70	115
	219	19	20	30	70	115
	220	20	20	30	70	115
	221	21	20	35	65	115
	222	22	20	35	65	115
	223	23	25	35	75	125
	224	24	25	35	75	125
	225	25	25	35	75	125
	228	28	25	35	75	125
	230	30	32	40	95	150
	232	32	32	45	90	150
	238	38	32	55	80	150
	240	40	32	60	75	150
	250	50	32	65	80	160

ZSEL, ZSEXL (Flat)



Carbide

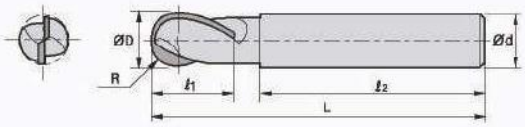
Substrate FCC PG22 IF

OD	Tolerance
All	0 ~ -0.050

(mm)

Designation		ØD	Ød	ℓ1	ℓ2	L
ZSEL	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	65	180
	232	32	32	90	65	190
	235	35	32	100	65	200
	240	40	42	100	105	220
	245	45	42	120	95	230
	250	50	42	120	95	230
ZSEL	416	16	16	50	55	120
	420	20	20	60	65	140
	425	25	25	70	65	150
	430	30	32	80	65	180
	435	35	32	100	65	200
	440	40	42	100	105	220
ZSEXL	220	20	20	120	65	200
	222	22	20	120	65	200
	225	25	25	140	65	220

ZSBE200 (Ball)



ØD	Tolerance
All	0 ~ - 0.050

(mm)

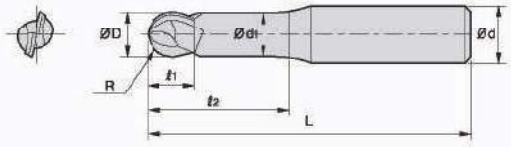
Designation		R	ØD	Ød	ℓ1	ℓ2	L
ZSBE	213	6.5	13	16	30	60	100
	214	7	14	16	30	65	100
	215	7.5	15	16	35	55	100
	216Q	8	16	16	35	55	100
	217	8.5	17	20	35	65	110
	218	9	18	20	35	65	110
	219	9.5	19	20	35	65	110
	220Q	10	20	20	35	65	110
	221	10.5	21	20	35	65	110
	222	11	22	20	35	65	110
	223	11.5	23	25	40	65	120
	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 : ZSBE2○○○-L
  Ex.1) 2 flutes diameter : 6.3 l: 10 L: 60 ZSBE 206310-60L
  Ex.2) 2 flutes, diameter : 6.3, standard type ZSBE2063

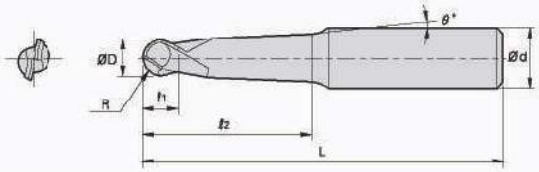
- **ZSEA200**
  Special Endmills order : ZSEA2○○○-L
  Ex.1) 2 flutes, diameter : 16.3, l:28, L:95 ZSEA2163 28-95L
  Ex.2) 2 flutes, diameter : 17.0, standard type ZSEA2170

- **ZSEL200/400, ZSEXL200**
  Special Endmills order : ZSEL○○○○-L

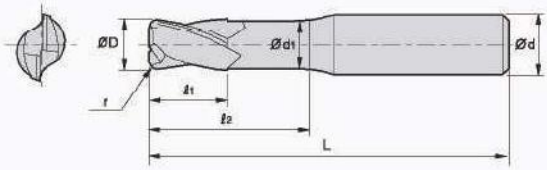
F Special Endmill order form



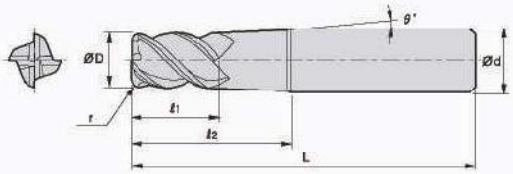
Designation	Flute	R	ØD	Ød	Ød1	ℓ1	ℓ2	L



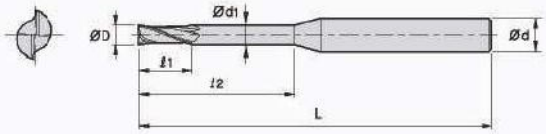
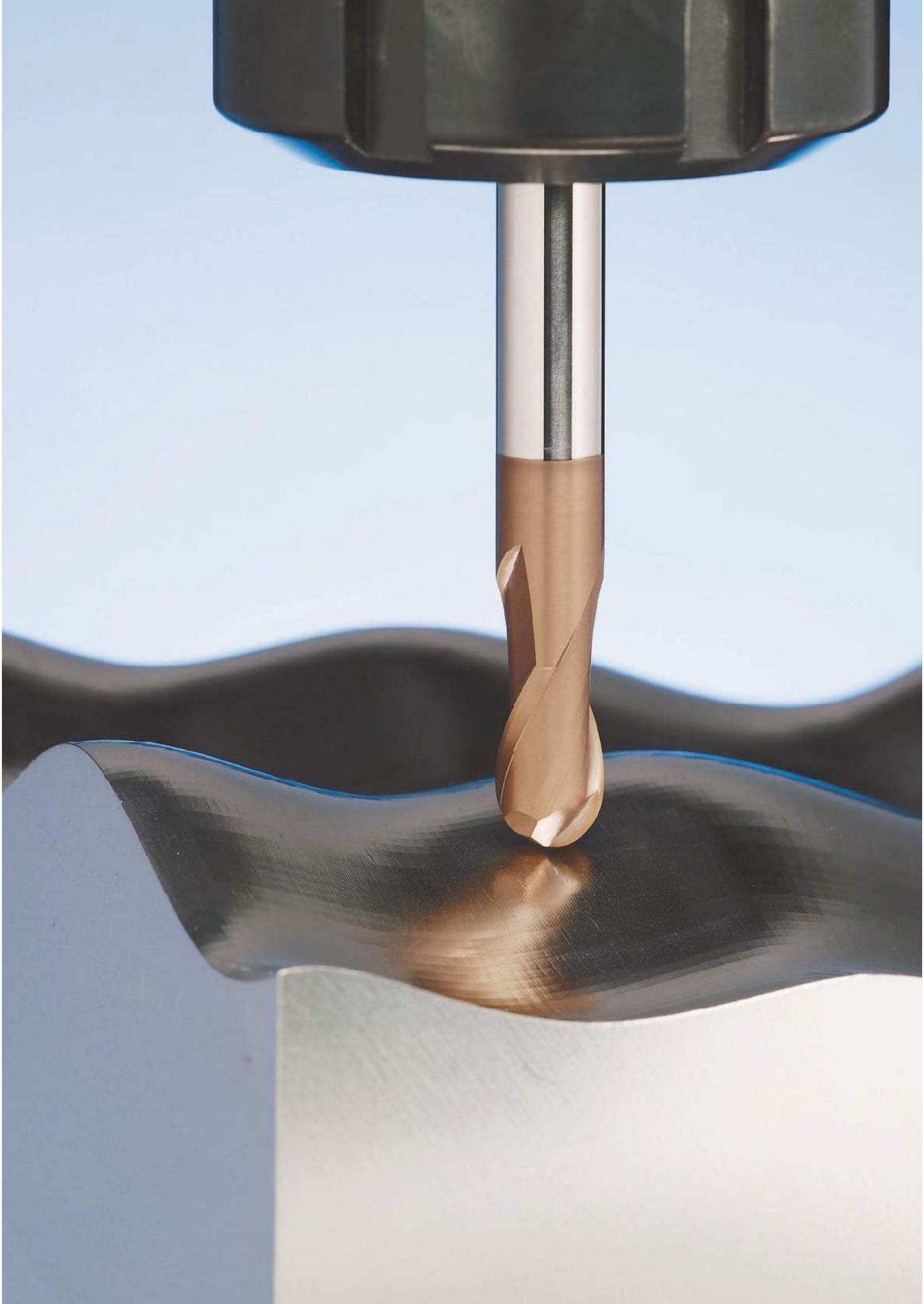
Designation	Flute	R	ØD	Ød	ℓ1	ℓ2	L	θ°



Designation	Flute	ØD	Ød	Ød1	r	ℓ1	ℓ2	L



Designation	Flute	ØD	r	Ød	ℓ1	ℓ2	L	θ°



Designation	Flute	ØD	Ød	Ød1	ℓ1	ℓ2	L