

6 Flutes Ball End Mill for High-efficiency Finishing



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Features of EPHB-PN



High-efficiency machining is possible than conventional ball end mills. Use of outer side cutting edge maximizes the tool performance.

More effective machining is possible by using 5-axis MC.

02

High accuracy and long tool life

Employed original cutting edge geometry which tuned 6 edges finely. High accuracy machining with long tool life is possible since each edge work uniformly even with micro cutting depth.

03 High rigidity design

Tool rigidity increased as much as possible in order to suppress the deflection of the tool occurred during cutting. High precision machining is realized with cutting edge design suitable for finishing. Furthermore, abrasion is suppressed by applying PN

Coating and it improves tool life.



EPH	B	-P	Ν	
RE3~RE6	[4	Items]

Features

Copper

6 flutes specification enables finishing at feed rate of 20m/min.

O High feed (21m/min) 5-axis finishing

6Flutes Ball End Mill EPHB6080-PN (RE4) Work material : S50CAn=15,000min⁻¹ ($v_c=377$ m/min) $v_f=21,000$ mm/min ($f_z=0.23$ mm/t) Stock material=0.1mm Pick feed : 0.15mm Dry(Air Blow) 5-axis MC.





High accuracy and long tool life

Comparison of cutting resistance during 45° inclined surface finishing

6Flutes Ball End Mill EPHB6100-PN (RE5) Work material : S50C (A 45° inclined surface *n*=11,666min⁻¹(vc=366m/min) vf=21,000mm/min(*fz*=0.3mm/t) Stock material=0.1mm Pick feed : 0.2mm Dry(Air Blow) 3-axis MC.



Because the runout of cutting edges is small as possible, spike of cutting force is small. Also, the damage of each edges are uniformity, then high-accuracy machining can be done for a long time.

Features **13** High rigidity design

It employed a positive cutting edge geometry which is more rigid than general ball end mills and suitable for finishing.

Applying PN Coating and realizes longer tool life.

PN Coating

Features

Features

- · A heat-resistant coating material with excellent adhesion to the tool substrate was achieved by optimizing the AI content.
- · Exhibits with good wear resistance due to doping of the AICr coating layer with Si.
- Exhibits excellent cutting life for cutting materials such as plastic molds, etc. where tool seizure often occurs.
- (2x the cutting life compared to conventional products.) Provides the long life in cutting processing of materials starting with HPM-MAGIC and including prehardened steel, carbon steel, alloy steel, SUS, SKD61, SKD11, etc.
- · By improving heat resistance, long life are possible for both wet cutting and dry cutting.
- Note) This product obtains less electric conductivity. Therefore, Please caution of using electric transmitted measuring systems.

Characteristics



Line Up

6 flutes





EPHB6000-PN

		Size (mm)							
Item code	Stock	Ball radius	Tool dia.	Flute length	Overall Length	Shank dia.	No. of flutes		
		RE	DC	APMX	LF	DCONMS			
EPHB6060-PN		3	6	6	90	6	6		
EPHB6080-PN	\bullet	4	8	8	100	8	6		
EPHB6100-PN		5	10	10	100	10	6		
EPHB6120-PN	\bullet	6	12	12	110	12	6		

• 6 flutes usable range by ball radius

It is usable with 3-axis MC since tool center has cutting edges even 2 flutes. EPHB-PN could performe at its true potential by using the following 6 flutes range with 5-axis machine,etc..



* Angle represents non-6 flutes part. When machining with spindle tilted, please set the angle of spindle considering ap etc.

O Re-grinding compatibility range table

Item code	Product name	Line up	Shane	Re-grinding compatibility range (mm)		
nem oode	r foddot hame	(mm)	Chape	Outer dia.	End	
EPHB-PN	6 Flutes Ball End Mill for High-efficiency Finishing	6~12		N/A	6~12	

04

Recommended cutting conditions



Standard cutting conditions (Finishing)

Wo mate	ork erial	Car	rbon steels (180~2	s, Alloy st 250HB)	eels	Stainles steels, Tool steels (25~35HRC)				Pre-hardened steels (35~45HRC)			
Ball	Tool	Cutting speed vc=200m/min				Cutting speed vc=180m/min				Cutting speed vc=160m/min			
radius RE (mm)	dia. DC (mm)	Revolution <i>n</i> min ⁻¹	Feed rate <i>V</i> f mm/min	a p (mm)	a e (mm)	Revolution <i>n</i> min ⁻¹	Feed rate <i>V</i> f mm/min	a p (mm)	a e (mm)	Revolution <i>n</i> min ⁻¹	Feed rate <i>V</i> f mm/min	a p (mm)	a e (mm)
RE3	6	10,600	5,720	≦0.2	≦0.2	9,500	5,130	≦0.2	≦0.2	8,500	4,590	≦0.2	≦0.2
RE4	8	8,000	5,760	≦0.3	≦0.3	7,200	5,180	≦0.2	≦0.2	6,400	4,610	≦0.2	≦0.2
RE5	10	6,400	5,760	≦0.3	≦0.3	5,700	5,130	≦0.3	≦0.3	5,100	4,590	≦0.2	≦0.2
RE6	12	5,300	5,720	≦0.3	≦0.3	4,800	5,180	≦0.3	≦0.3	4,200	4,540	≦0.3	≦0.3



High speed cutting conditions (Finishing)

Wo	rk	Car	bon steel	s, Alloy st	eels	Stai	Stainles steels, Tool steels				Pre-hardened steels			
mate	erial		(180~2	250HB)		(25~35HRC)				(35~45HRC)				
Ball	Tool	Cutting speed vc=375m/min				Cutting speed vc=340m/min				Cutting speed vc=300m/min				
RE (mm)	dia. DC (mm)	Revolution <i>n</i> min ⁻¹	Feed rate <i>V</i> f mm/min	a p (mm)	a e (mm)	Revolution <i>n</i> min ⁻¹	Feed rate <i>V</i> f mm/min	a p (mm)	a e (mm)	Revolution <i>n</i> min ⁻¹	Feed rate <i>V</i> f mm/min	a p (mm)	a e (mm)	
RE3	6	19,900	21,490	≦0.1	≦0.1	17,900	19,330	≦0.1	≦0.1	15,900	15,450	≦0.1	≦0.1	
RE4	8	14,900	21,460	≦0.1	≦0.1	13,400	19,300	≦0.1	≦0.1	11,900	15,420	≦0.1	≦0.1	
RE5	10	11,900	21,420	≦0.2	≦0.2	10,700	19,260	≦0.2	≦0.2	9,500	15,390	≦0.1	≦0.1	
RE6	12	9,900	21,380	≦0.2	≦0.2	9,000	19,440	≦0.2	≦0.2	8,000	15,550	≦0.2	≦0.2	

[Note]

① High speed cutting conditions are applicable as long as projection length of 3DC or less and work shape that can be followed by high performance MC.

② Since cutting edge is designed even to the tip, it can be used for 3-axis machining. However, in order to allow the 6 flutes to function, please use it by tilting more than 30°.

(a) When machining near the center of the ball-nosed end cutting edge, please adjust the feed speed to about one third.

④ ae is a reference value. Please refer to cusp height etc. and set it.

⑤ Use the appropriate coolant for the work material and machining shape.

⁽⁶⁾ Use a highly rigid and accurate machine as possible.

⑦ These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.

(8) If the rpm available is lower than that recommended please reduce the feed rate to the same ratio.

Ball end mill pick feed and theoretical cusp height table (µm)

	Pick feed and Cusp height								
		0.05	0.1	0.2	0.3	0.4	0.5	0.6	$H=RE-\sqrt{RE^2-pf^2/4} = pf^2/8RE$
	3	0.104	0.417	1.667	3.752	6.674	10.435	15.038	
	4	0.078	0.313	1.250	2.813	5.003	7.820	11.266	RE
(mm)	5	0.063	0.250	1.000	2.251	4.002	6.254	9.008	Н
. ,	6	0.052	0.208	0.833	1.875	3.334	5.211	7.505	+pi →

Application Data

• Tool life test with 1,400m cutting length on 45° inclined surface

6Flutes Ball End Mill EPHB6080-PN(RE4) Work material : HPM7 45° inclined surface n=12,000 min⁻¹($v_c=301$ m/min) $v_f=8,640$ mm/min ($f_z=0.12$ mm/t) Cutting time 162 min. $a_p \times a_e = 0.3$ mm×0.3 mm (Cusp height 2.8 µm) 3-axis MC.



EPHB-PN with each cutting edge finely tuned can keep cutting amount uniform. The wear is uniform and small evenafter 1,400m cutting. Even when comparing the work surface roughness after cutting 1,400m, there is no major change from the initial machining.

Comparison of finished surface roughness with 2 flutes ball end mill

2 Flutes Ball End Mill (RE4)

Work material : PX5 n=12,000 min⁻¹($v_c=301$ m/min) $v_f=1,440$ mm/min($f_z=0.06$ mm/t) Stock material : 0.1 mm Pick feed : 0.4 mm 3-axis MC. Dry (Air blow)



Manhan

2 flutes ball end mill Ra: $0.65\mu m$ Rz: $3.455\mu m$

EPHB6080-PN (RE4) Work material : PX5 n=12,000min⁻¹($v_c=301$ m/min) $v_f=2,880$ mm/min ($f_z=0.04$ mm/t) Stock material : 0.1mm Pick feed : 0.2mm 3-axis MC. Dry (Air blow)





EPHB6080-PN Ra:0.276µm Rz:1.67µm

Finished surface roughness was improved since pick feed can be reduced by the increase of feed speed.

O Comparison of cutting performance with large diameter indexable tool

RE15×2NT (Left side) Surface roughness <u>Ra 1.435µm Rz</u> 10.400µm EPHB6080-PN (Right side) Surface roughness Ra 1.084µm Rz 7.096µm

Work material : FCD400 200mm×100mm Corner R area : 10R 5-axis MC. Dry(Air blow)

*a*e = 0.3mm



RE15 Indexable tool

n=6,000 min⁻¹(vc=565 m/min) vf=4,000 mm/min (fz=0.33 mm/t) $a_e=0.6$ mm (Remaining stock at corner)

2.5 times or more machining efficiency

 $n = 14,900 \text{min}^{-1}(v_c = 375 \text{m/min})$ $v_f = 21,460 \text{mm/min}(f_z = 0.24 \text{mm/t})$

RE4 EPHB6080-PN

In addition to high-efficiency machining, corners can be finished with a single tool. As there is no step due to tool change, more precise finished surface can be obtained



The diagrams and table data are examples of test results, and are not guaranteed values. "MOLDINO" is a registered trademark of MOLDINO Tool Engineering, Ltd.

Attentions on Safety

1. Cautions regarding handling

(1) When removing the tool from its case (packaging), be careful that the tool does not pop out or is dropped. Be particularly careful regarding contact with the tool flutes. (2) When handling tools with sharp cutting flutes, be careful not to touch the cutting flutes directly with your bare hands.

2. Cautions regarding mounting

(1) Before use, check the outside appearance of the tool for scratches, cracks, etc. and that it is firmly mounted in the collet chuck, etc.

(2) If abnormal chattering, etc. occurs during use, stop the machine immediately and remove the cause of the chattering.

3. Cautions during use

- (1) Before use, confirm the dimensions and direction of rotation of the tool and milling work material.
- (2) The numerical values in the standard cutting conditions table should be used as criteria when starting new work. The cutting conditions should be adjusted as appropriate when the cutting depth is large, the rigidity of the machine being used is low, or according to the conditions of the work material. (3) Cutting tools are made of a hard material. During use, they may break and fly off. In addition, cutting chips may also fly off. Since there is a danger of injury to
- workers, fire, or eye damage from such flying pieces, a safety cover should be attached when work is performed and safety equipment such as safety goggles should (4) There is a risk of fire or inflammation due to sparks, heat due to breakage, and cutting chips. Do not use where there is a risk of fire or explosion. Please caution of
- fire while using oil base coolant, fire prevention is necessary.
- (5) Do not use the tool for any purpose other than that for which it is intended.

4. Cautions regarding regrinding

- (1) If regrinding is not performed at the proper time, there is a risk of the tool breaking. Replace the tool with one in good condition, or perform regrinding.
- (2) Grinding dust will be created when regrinding a tool. When regrinding, be sure to attach a safety cover over the work area and wear safety clothes such as safety
- goggles, etc. (3) This product contains the specified chemical substance cobalt and its inorganic compounds. When performing regrinding or similar processing, be sure to handle the processing in accordance with the local laws and regulations regarding prevention of hazards due to specified chemical substances.

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