



Barrel, Lens & Taper Shape Tools for Finishing

Vol 1

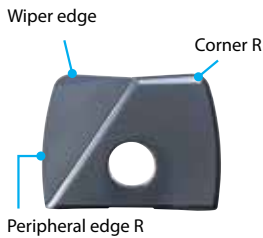
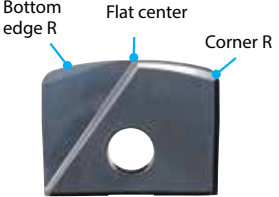
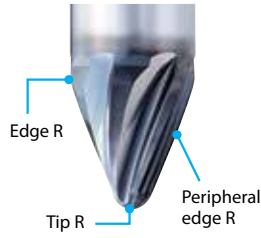
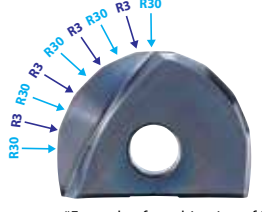
# Barrel & Lens Solutions

PHOENIX® PFB-BR • PHOENIX® PFB-LZ • EXOCARB® VU-TBR



## Large Radius Configuration

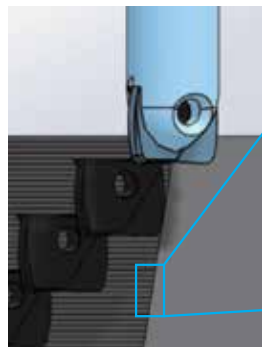
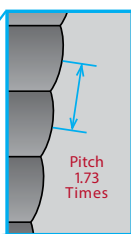
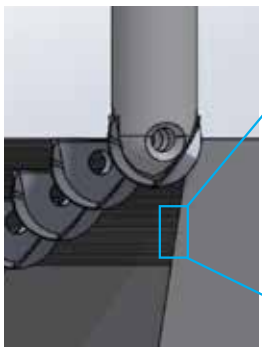
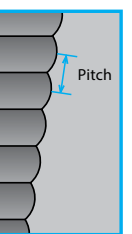
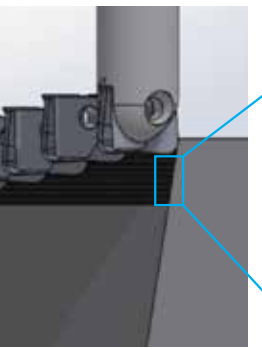

Superior Machining Efficiency and Surface Quality with Large Radius Configuration

Indexable Type (PFB)		Solid Type	Composite Radius Shape Type
<p><b>PFB-BR</b> Barrel Type Insert</p> <ul style="list-style-type: none"> <li>Contour milling of vertical slope</li> <li>Flat bottom milling</li> </ul> 	<p><b>PFB-LZ</b> Lens Type Insert</p> <ul style="list-style-type: none"> <li>Copy milling of horizontal slope</li> <li>Copy milling of curved surface</li> </ul> 	<p><b>VU-TBR</b> Taper Barrel Type</p> <ul style="list-style-type: none"> <li>Contour milling of vertical slope</li> <li>High-efficiency multi-flute specification</li> </ul> 	<p><b>PolyBall</b> Special Tool</p> <p>Improves machined surface quality and reduces processing time for complex shapes with inclined and curved surfaces.</p>  <p>*Example of combination of Rs.</p>
<b>P.04</b>		<b>P.14</b>	<b>P.18</b>

## Capable of Milling with a Larger Pitch

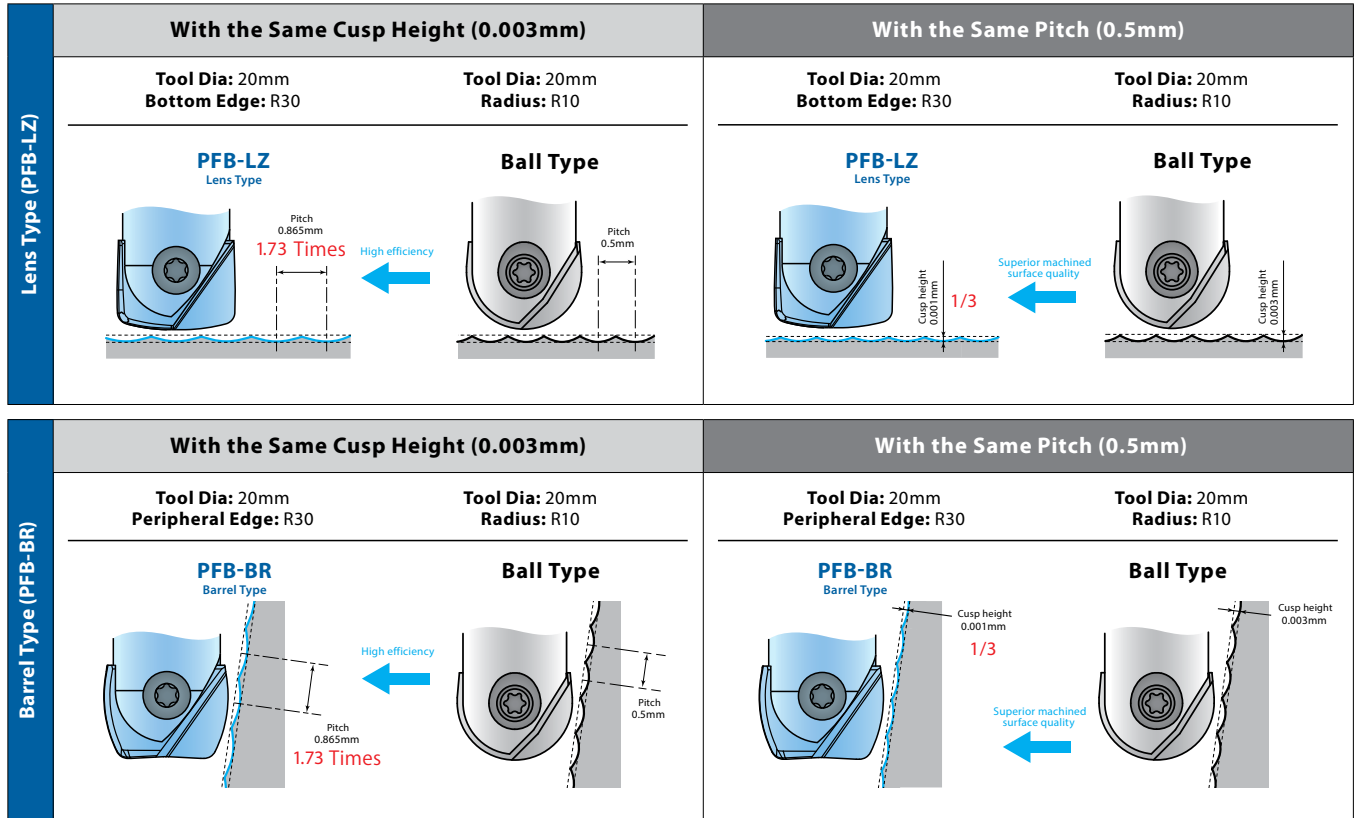
Compared to Conventional Tooling

The barrel type (PFB-BR) can be used with a larger pitch than with the ball type and corner radius type when contour milling with the same theoretical cusp height value.

<b>PFB-BR</b> Barrel Type Insert	Ball End Mill Insert	Corner Radius End Mill Insert
<p><b>Tool Dia: 20mm</b> <b>Barrel Radius: R30</b></p>  <p>Higher efficiency can be achieved.</p>  <p>Pitch 1.73 Times</p>	<p><b>Tool Dia: 20mm</b> <b>Radius: R10</b></p>   <p>Pitch</p>	<p><b>Tool Dia: 20mm</b> <b>Corner Radius: R3</b></p>   <p>Pitch 0.3 Times</p>

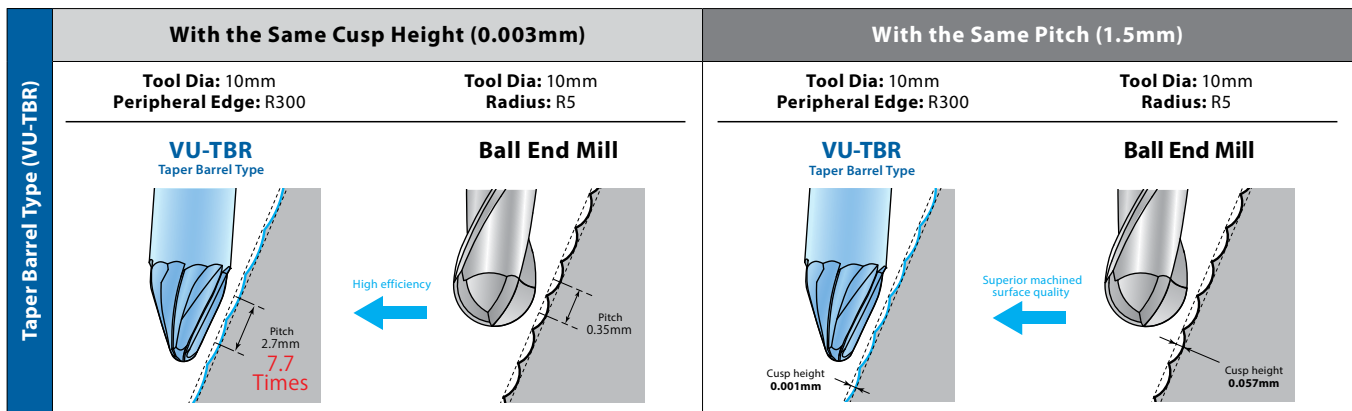
## Large Pitch Greatly Improves Cutting Efficiency

Compared to Conventional Tooling



## Highly Efficient Finishing with Large Peripheral Edge R

Compared to Conventional Tooling



# Ball End Mill for Finishing

## Barrel and Lens Shape Inserts

Original geometry that enables smooth machined surface and higher cutting efficiency.

**PFB-BR**  
Barrel Type



**Wiper Edge**

**Corner R**

**Peripheral edge R**

**Contour milling of vertical slope**

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**Flat bottom milling**

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**Applicable to vertical slopes up to 17.1°**  
(see table below)

\* For 3-axis machining





Vertical slope angle

Applicable maximum vertical slope angle

Ø10 (R15)	16.6°
Ø12 (R18)	17.1°
Ø16 (R24)	15.8°
Ø20 (R30)	16.6°
Ø25 (R37.5)	16.6°
Ø32 (R48)	16.7°

**PFB-LZ**  
Lens Type



**Bottom Edge R**

**Flat Center**

**Corner R**

**Copy milling of horizontal slope**

---

**Copy milling of curved surface**

---

**Applicable to horizontal slopes up to 15.7°**  
(see table below)

\* For 3-axis machining





Horizontal slope angle

Applicable maximum horizontal slope angle

Ø10 (R15)	15°
Ø12 (R18)	15.7°
Ø16 (R24)	14.4°
Ø20 (R30)	14.7°
Ø25 (R37.5)	15.1°
Ø32 (R48)	15.4°

## Insert Grades Selected According to Application

### XP3225 Grade

- For stable milling of a wide variety of work materials
- Excellent lubricity and wear resistance

### XP3310 Grade

- Ideal for dry milling of high hardened steel and cast iron
- Excellent heat and wear resistance

## PFB-BR

### 3-Axis Finishing of Mold Base by PFB-BR Barrel Tool (FCD550R)

The pitch is set to twice that of conventional tool. The finished surfaces are extremely satisfactory for both vertical slopes, with the processing efficiency increased by about 30%.

Tool	PFB-R320SS32-LL300CS		Ø40 x R3 Conventional Shoulder Cutter
Insert (Grade)	PFB320R480-BR-ST (XP3225)		
Work Material	FCD550R		
Cutting Speed	656 SFM (1990 RPM)	410 SFM (995 RPM)	
Feed	23.6 IPM (0.0059 in/t)	27.5 IPM	
Pitch	0.0275 in	0.0138 in	
Depth of Cut	0.0118 in	0.0118 in	
Overhang Length	6.929 in		
Coolant	Air		
Machining Time	2h 12m 8s	5h 39m 55s	
Machined Surface	Set to almost the same cusp height		
Machine	HMC		



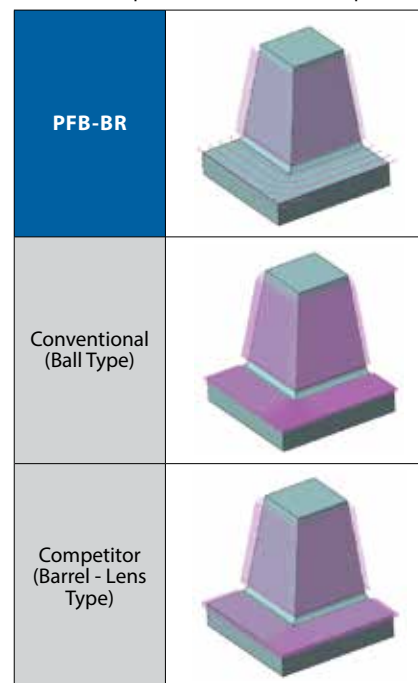
## PFB-BR

### 3-Axis Finishing of Die Casting Mold by PFB-BR Barrel Tool (FCD550R)

Processing time can be reduced with the larger pitch of the barrel type tool's R30. In addition, the wiper edge of the barrel type tool (PFB-BR) enables higher quality of the bottom surface. Moreover, with the bottom pitch of 0.6 DC (12 mm), processing time can be significantly reduced compared to the ball shape and other competitors' barrel and lens type tools.

Tool	PFB-R320SS32-LL300CS	R10 Conventional Ball Nose	R20 Competitor Barrel-Lens
Insert (Grade)	PFB320R480-BR-ST (XP3225)		
Work Material	SKD61 (45 HRC)		
Cutting Speed	492 SFM (2387 RPM)		
Feed	18.8 IPM (0.0039 in/t)		
Pitch	0.0398 in	0.0232 in	0.0338 in
Depth of Cut	0.0039 in	0.0039 in	0.0039 in
Overhang Length	4.331 in		
Coolant	Water-Soluble		
Machining Time	27m 20s	46m 19s	31m 53s
Cusp Height	0.0002 in		
Surface Roughness	Ra = 0.49 µm Rz = 2.1 µm	Ra = 0.88 µm Rz = 23.4 µm	Ra = 0.65 µm Rz = 22.8 µm
Machine	VMC		

Difference in path based on insert shape

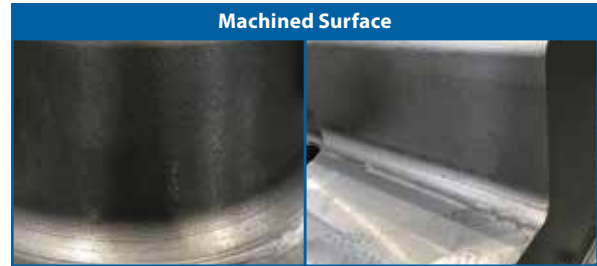
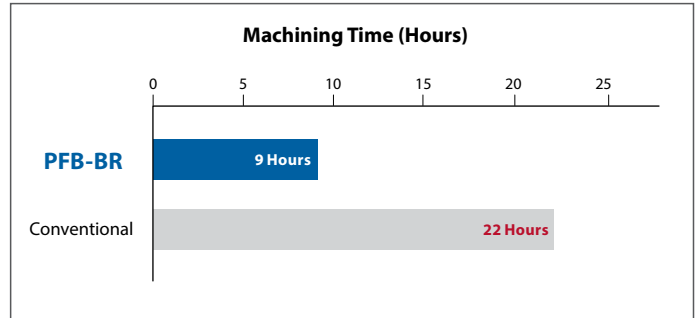


## PFB-BR

### 3-Axis Finishing of Mold Base by PFB-BR Barrel Tool (FCD550R)

Achieved significant increase in efficiency. With the conventional tool, the insert has to be replaced after milling one workpiece. The PFB-BR, however, can complete two or more workpieces before having to be replaced.

Tool	Special	Ø40 x R3 Conventional Shoulder Cutter
Insert (Grade)	PFB200R320-BR-ST (XP3225)	
Work Material	FCD550R	
Cutting Speed	600 SFM (2900 RPM)	370 SFM (900 RPM)
Feed	25.6 IPM (0.0043 in/t)	19.7 IPM
Pitch	0.0393 in	0.0138 in
Depth of Cut	0.0236 in	0.0236 in
Overhang Length	5.709 in	
Coolant	Air	
Machining Time	<b>9h</b>	<b>22h</b>
Machined Surface	Set to almost the same cusp height	
Machine	HMC	

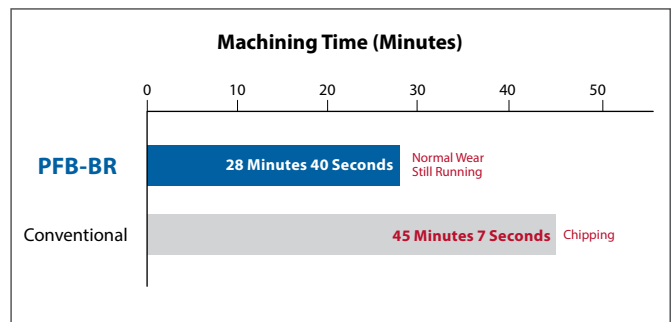


## PFB-BR

### 3-Axis Finishing of Fixed Die by PFB-BR Barrel Tool (DH315)

The conventional radius type insert needs to be replaced before finishing one workpiece due to small pitch. With the barrel type insert (PFB-BR), because the cutting distance became shorter due to the larger pitch, it was possible to complete cutting one workpiece without replacing the tool. The level of precision was also high enough to eliminate polishing.

Tool	PFB-R200SF10	Ø20 x R3 Conventional Radius Cutter
Insert (Grade)	PFB200R300-BR-ST (XP3225)	
Work Material	DH315	
Cutting Speed	721 SFM (3510 RPM)	
Feed	38.7 IPM (0.0055 in/t)	68.9 IPM (0.0110 in/t)
Pitch	0.0315 in	0.0138 in
Depth of Cut	0.0059 in	0.0059 in
Overhang Length	3.858 in	
Coolant	Air	
Machining Time	<b>28m 40s</b>	<b>45m 7s</b>
Cusp Height	0.00008 in	0.0002 in
Machine	HMC	



#### Finished Surface by PFB-BR



The machined surface quality was so superior that a clear reflection can be seen.

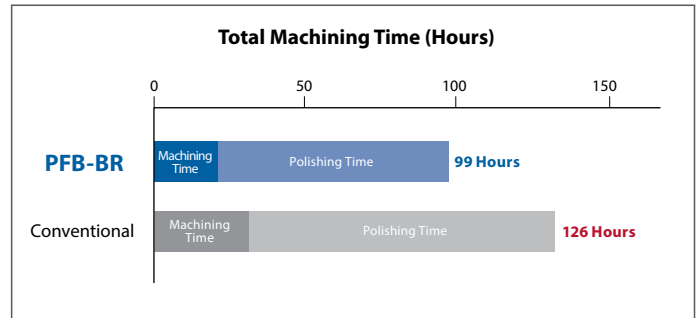
PFB-BR	Conventional
Wear: 0.011mm	Wear: 0.046mm
Wear: 0.014mm	Wear: 0.088mm

## PFB-BR

### Finishing of Large Die by PFB-BR Barrel Tool (SC410 Cast Steel)

Smooth and considerably high quality surface is achieved due to the effect of the large barrel R. As the surface becomes smoother, polishing time can be significantly reduced and thus the total time required for finishing can also be significantly reduced. By making the pitch larger, the cutting distance is shortened, minimizing the number of tools required for processing.

Tool	PFB-R320SS32-LL300CS	R6 Conventional Ball Nose
Insert (Grade)	PFB320R480-BR-SH (XP3310)	
Work Material	SC410 Cast Steel	
Cutting Speed	820 SFM (2500 RPM)	330 SFM (2680 RPM)
Feed	31.5 IPM (0.0063 in/t)	70.9 IPM
Pitch	0.1181 in	0.0787 in
Cusp Height	0.0009 in	0.0033 in
Overhang Length	6.890 in	
Coolant	Air	
Machining Time	1.5h x 18pcs = 27h	1h x 18pcs = 18h
Polishing Time	4h x 18pcs = 72h	6h x 18pcs = 108h
Total Time	<b>99h</b>	<b>126h</b>
Machine	Double Column MC	

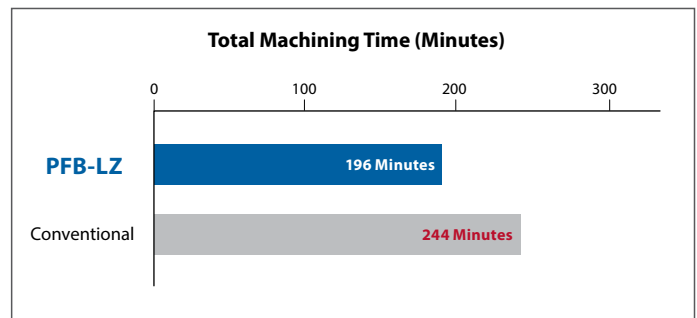


## PFB-LZ

### 5-Axis Finishing of Blade by PFB-LZ Lens Tool (430 Stainless Steel)

By using PFB-LZ R30 to make the pitch larger, machining time is shortened.

Tool	PFB-R200SF10	R20 Competitor Lens Tool
Insert (Grade)	PFB200R300-LZ-ST (XP3225)	
Work Material	430 Stainless Steel	
Cutting Speed	1640 SFM (7961 RPM)	
Feed	94.0 IPM (0.0059 in/t)	94.0 IPM (0.0039 in/t)
Pitch	0.0488 in	0.0398 in
Cusp Height	0.0079 in	0.0079 in
Overhang Length	3.543 in	
Coolant	Water-Soluble	
Cusp Height	0.0002 in	
Machining Time	<b>196 m</b>	<b>244 m</b>
Number of Parts	12	
Machine	Turbine Blade-processing machine	

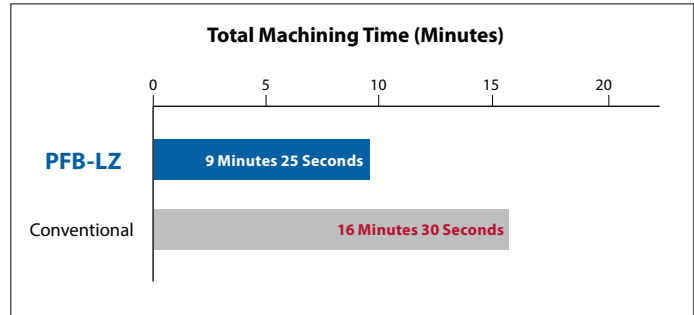


## PFB-LZ

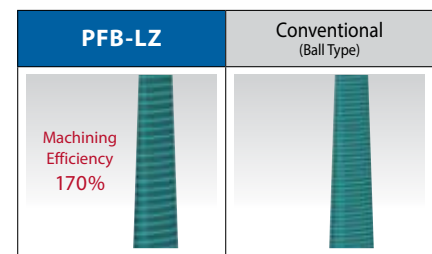
### 5-Axis Finishing of Turbine Blade by PFB-LZ Lens Tool (430 Stainless Steel)

Significant processing time reduction is achieved.

Tool	PFB-R200SS20-L180CS		R10 Conventional Ball Nose
Insert (Grade)	PFB200R300-LZ-ST (XP3225)		
Work Material	430 Stainless Steel		
Cutting Speed	1377 SFM (6687 RPM)		
Feed	210.6 IPM (0.0157 in/t)		
Pitch	0.0341 in	0.0197 in	
Cusp Height	0.0079 in	0.0079 in	
Tool Tilt Angle	15°		
Overhang Length	3.543 in		
Coolant	Water-Soluble		
Cusp Height	0.0001 in		
Machining Time	<b>9m 25s</b>	<b>16m 30s</b>	
Machine	5-Axis VMC		



#### Difference in Tool Path



## PFB-LZ

### Finishing of Large Die Parts by PFB-LZ Lens Tool (PX5)

Conventionally, after roughing was performed by a vertical machining center, the finished surface would be transferred to a horizontal machining center for finishing by face milling with the tooling block tilted at 4°. By using the lens type tool (PFB-LZ), work setup time is greatly reduced to achieve large cost reduction.

Tool	PFB-R320SS32-LL300CS
Insert (Grade)	PFB320R480-LZ-SH (XP3310)
Work Material	PX5
Cutting Speed	740 SFM (2250 RPM)
Feed	25.6 IPM (0.0059 in/t)
Pitch	0.0315 in
Depth of Cut	0.0079 in
Overhang Length	6.929 in
Coolant	Air
Cusp Height	0.00008 in
Machining Time	<b>2h 30m</b>
Machine	VMC

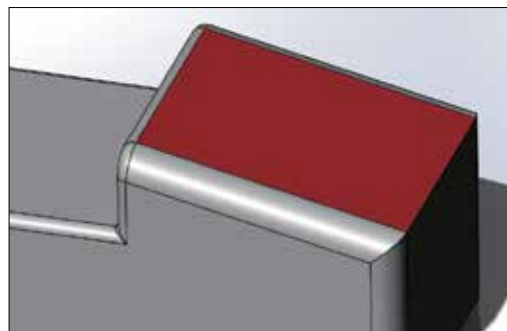


Illustration of a portion of the workpiece (4° horizontal slope)

#### Machined Surface





## Tailored Tooling for Specific Machining Requirements

### Appearance



Lens Type Insert  
 Ø16 Bottom edge R60



Oval Type Insert  
 Ø16 Composite R40-R8



Oval Type End Mill



Barrel Type End Mill

### Surface Treatment



Diamond Coating



DLC Coating

### Exchangeable Head End Mill



Barrel Type



Lens Type

Please contact your local sales representative for details.

# List 78014

PFB SS (Metric)



**SPEED FEED**  
P13

Recommended Materials: 13  
Accessories & Inserts: p12



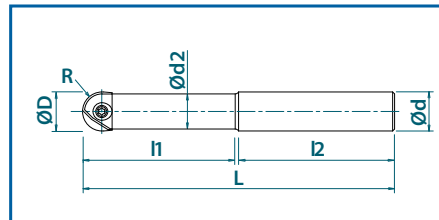
Steel Shank



Carbide Shank

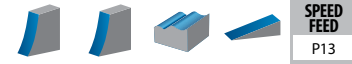
EDP No.	Body Type	Designation	Tool Dia. (mm)	Tool Radius (mm)	Overall Length (mm)	Neck Length (mm)	L/D Ratio	No. of Teeth	Shank Dia. (mm)	Shank Length (mm)	Neck Dia. (mm)
			D	R	L	l1			d	l2	d2
7801400	Cylindrical Shank Steel	PFB-R080SS08-S120	8	4	120	36	4.5	2	8	84	7
7801401		PFB-R100SS10-S130	10	5	130	45	4.5	2	10	85	9
7801402		PFB-R120SS12-S130	12	6	130	54	4.5	2	12	76	11
7801403		PFB-R160SS16-S140	16	8	140	65	4	2	16	76	14
7801404		PFB-R200SS20-S160	20	10	160	80	4	2	20	80	18
7801405		PFB-R250SS25-S160	25	12.5	160	75	3	2	25	85	22
7801406		PFB-R300SS32-S170	30	15	170	90	3	2	32	80	27
7801407	PFB-R320SS32-S180	32	16	180	96	3	2	32	84	29	
7801429	Cylindrical Shank Short Carbide	PFB-R060SS06-S80CS	6	3	80	15	2.5	2	6	65	5.4
7801430		PFB-R080SS08-S100CS	8	4	100	20	2.5	2	8	80	7
7801431		PFB-R100SS10-S100CS	10	5	100	25	2.5	2	10	75	9
7801432		PFB-R120SS12-S110CS	12	6	110	30	2.5	2	12	80	11
7801433		PFB-R160SS16-S140CS	16	8	140	40	2.5	2	16	100	14
7801434		PFB-R200SS20-S160CS	20	10	160	50	2.5	2	20	110	18
7801435		PFB-R250SS25-S160CS	25	12.5	160	62.5	2.5	2	25	97.5	22
7801436	PFB-R300SS32-S170CS	30	15	170	75	2.5	2	32	95	27	
7801437	PFB-R320SS32-S180CS	32	16	180	80	2.5	2	32	100	29	
7801439	Cylindrical Shank Long Carbide	PFB-R060SS06-L100CS	6	3	100	30	5	2	6	70	5.4
7801440		PFB-R080SS08-L120CS	8	4	120	40	5	2	8	80	7
7801441		PFB-R100SS10-L130CS	10	5	130	50	5	2	10	80	9
7801442		PFB-R120SS12-L140CS	12	6	140	60	5	2	12	80	11
7801443		PFB-R160SS16-L160CS	16	8	160	72	4.5	2	16	88	14
7801444		PFB-R200SS20-L180CS	20	10	180	90	4.5	2	20	90	18
7801445		PFB-R250SS25-L200CS	25	12.5	200	100	4	2	25	100	22
7801446	PFB-R300SS32-L220CS	30	15	220	120	4	2	32	100	27	
7801447	PFB-R320SS32-L230CS	32	16	230	128	4	2	32	102	29	
7801419	Cylindrical Shank Extra-Long Carbide	PFB-R060SS06-LL120CS	6	3	120	42	7	2	6	78	5.4
7801420		PFB-R080SS08-LL140CS	8	4	140	56	7	2	8	84	7
7801421		PFB-R100SS10-LL150CS	10	5	150	70	7	2	10	80	9
7801422		PFB-R120SS12-LL160CS	12	6	160	84	7	2	12	76	11
7801423		PFB-R160SS16-LL200CS	16	8	200	96	6	2	16	104	14
7801424		PFB-R200SS20-LL240CS	20	10	240	120	6	2	20	120	18
7801425		PFB-R250SS25-LL260CS	25	12.5	260	137.5	5.5	2	25	122.5	22
7801426	PFB-R300SS32-LL290CS	30	15	290	165	5.5	2	32	125	27	
7801427	PFB-R320SS32-LL300CS	32	16	300	176	5.5	2	32	124	29	

Packed: 1 pc.

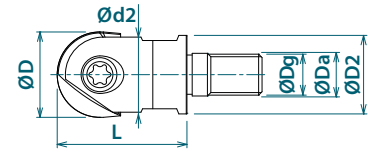


# List 78114

PFB SF (Metric)



Recommended Materials: 13  
Accessories & Inserts: p12  
SF Arbors: See Cutting Tool Solutions p.1462-1464



EDP No.	Body Type	Designation	Tool Dia. (mm)	No. of Teeth	Pilot Dia. (mm)	Thread Dia. (mm)	Overall Length (mm)	Head Dia. (mm)	Flange Dia. (mm)	Wrench Size	Applicable Insert
			D		Da	Dg		L	d2		
7801490	Screw Fit Head	PFB-R100SF6	10	2	6.5	M6	26	9	9.0	7	PFB...
7801491		PFB-R120SF6	12	2	6.5	M6	26	11	11	7	
7801492		PFB-R160SF8	16	2	8.5	M8	32	14	14.5	10	
7801493		PFB-R200SF10	20	2	10.5	M10	38	18	18	14	
7801494		PFB-R250SF12	25	2	12.5	M12	38	22	23	17	
7801495		PFB-R300SF16	30	2	17	M16	43	27	28	22	

Packed: 1 pc.

**This item is stocked overseas. Please contact OSG for availability and delivery.**



## OSG PHOENIX® SF

Screw-Fit End Mills

**SF Arbor SS**  
Cylindrical Shank Steel Arbor



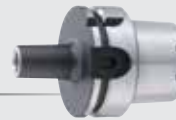
**SF Arbor SS**  
Cylindrical Shank Carbide Arbor



**SF Arbor BT**  
BT30/40 Arbor



**SF Arbor HSK**  
HSK-A63/100 Arbor



Please see OSG Cutting Tool Solutions catalog for details.

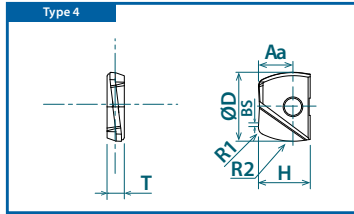


# List 78PFB

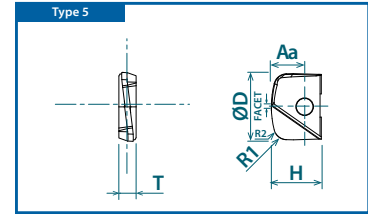
PFB Inserts (mm)



Barrel Type  
Type 4



Lens Type  
Type 5



Designation	Type	Specification	No. of Cutting Edges	Insert Size							EDP Number		
				D (mm)	R2 (mm)	R1 (mm)	Aa (mm)	BS (mm)	FACET (mm)	T (mm)	H (mm)	XP3225	XP3310
PFB100R150-BR-ST	4	Multi-Purpose Type	2	10	15	1	5	0.3	-	2.6	8.5	7820071	-
PFB120R180-BR-ST				12	18	1	6	0.3	-	3	10	7820072	-
PFB160R240-BR-ST				16	24	2	8	0.5	-	4	12	7820073	-
PFB200R300-BR-ST				20	30	2	10	0.5	-	5	15	7820074	-
PFB250R375-BR-ST				25	38	3	12.5	0.5	-	6	18.5	7820075	-
PFB320R480-BR-ST				32	48	3	16	0.5	-	7	23.5	7820076	-
PFB100R150-BR-SH	4	Reinforced Edge Type	2	10	15	1	5	0.3	-	2.6	8.5	-	7820081
PFB120R180-BR-SH				12	18	1	6	0.3	-	3	10	-	7820082
PFB160R240-BR-SH				16	24	2	8	0.5	-	4	12	-	7820083
PFB200R300-BR-SH				20	30	2	10	0.5	-	5	15	-	7820084
PFB250R375-BR-SH				25	38	3	12.5	0.5	-	6	18.5	-	7820085
PFB320R480-BR-SH				32	48	3	16	0.5	-	7	23.5	-	7820086
PFB100R150-LZ-ST	5	Multi-Purpose Type	2	10	15	1	3.3	-	0.75	2.6	8.5	7820091	-
PFB120R180-LZ-ST				12	18	1	4	-	0.75	3	10	7820092	-
PFB160R240-LZ-ST				16	24	2	5.3	-	1	4	12	7820093	-
PFB200R300-LZ-ST				20	30	2	6.7	-	1.75	5	15	7820094	-
PFB250R375-LZ-ST				25	38	3	8.3	-	1.75	6	18.5	7820095	-
PFB320R480-LZ-ST				32	48	3	10.7	-	2	7	23.5	7820096	-
PFB100R150-LZ-SH	5	Reinforced Edge Type	2	10	15	1	3.3	-	0.75	2.6	8.5	-	7820101
PFB120R180-LZ-SH				12	18	1	4	-	0.75	3	10	-	7820102
PFB160R240-LZ-SH				16	24	2	5.3	-	1	4	12	-	7820103
PFB200R300-LZ-SH				20	30	2	6.7	-	1.75	5	15	-	7820104
PFB250R375-LZ-SH				25	38	3	8.3	-	1.75	6	18.5	-	7820105
PFB320R480-LZ-SH				32	48	3	10.7	-	2	7	23.5	-	7820106

Packed: 1 pc.



# List 7808H

PFB Accessories

Appearance	EDP No.	Designation	Applicable Insert		Recommended Tightening Torque
			(inch)	(mm)	
 Clamping Screw	7808124	FS20652RB (Torx 6)	0.250	6-7	0.8 Nm
	7808123	FS25669RB (Torx 7)	-	8	1.0 Nm
	7808117	FS30686RB (Torx 8)	0.375	10	1.2 Nm
	7808118	FS35610RB (Torx 10)	0.500	12	2.0 Nm
	7808119	FS40613RB (Torx 15)	0.625	16	3.0 Nm
	7808120	FS50615RB (Torx 20)	0.750	20	5.0 Nm
	7808121	FS60620RB (Torx 20)	1.000	25	5.0 Nm
	7808122	FS80624RB (Torx 30)	1.250	30-32	6.0 Nm
 Wrench	7808203	T6-D (Torx 6)	0.250	6-7	
	7808204	T7-D (Torx 7)	-	8	
	7808205	T8-D (Torx 8)	0.375	10	
	7808207	T10-D (Torx 10)	0.500	12	
	7808208	T15-D (Torx 15)	0.625	16	
	7808209	T20-D (Torx 20)	0.750-1.000	20-25	
	7808212	T30-T (Torx 30)	1.250	30-32	

Packed: Clamping Screw = 1 pc.; Wrench = 1 pc.

Note: Wrench sold separately.

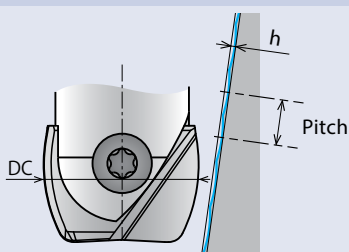


# PFB-BR & PFB-LZ Cutting Conditions

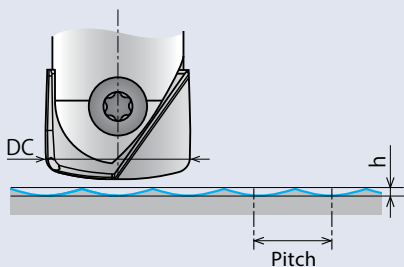
Work Material	Tensile Strength - Hardness	Milling Speed Vc (SFM)	Depth of Cut		Feed Per Tooth fz (in/t)		
			Pitch (mm)	Depth of Cut (in)	Ø10-12mm	Ø16-20mm	Ø25-32mm
<b>P</b> Mild Steels, Carbon Steels (1010, 1018) Carbon Steels, Alloy Steels (1050, 4140) Die Steels (H13, D2)	~180 HB	985 (655 - 2625)	Based on Cusp Height (see chart below)	0.0078	0.0047	0.0055	0.0071
	~280 HB	985 (655 - 2625)		0.0078	0.0039	0.0047	0.0055
	~280 HB	820 (490 - 1970)		0.0078	0.0039	0.0047	0.0055
<b>M</b> Stainless Steels (304SS, 420SS)	~250 HB	820 (490 - 2130)		0.0078	0.0047	0.0055	0.0067
<b>K</b> Cast Iron (FC250) Ductile Cast Iron (60-40-18)	~350 N/mm²	1310 (985 - 2625)		0.0078	0.0055	0.0071	0.0087
	~600 N/mm²	985 (655 - 2625)		0.0078	0.0047	0.0055	0.0071
<b>S</b> Heat Resistant Alloys (Inconel 718) Titanium Alloy (Ti-6Al-4V)	-	165 (80 - 260)		0.0059	0.0019	0.0024	0.0024
	-	295 (130 - 395)		0.0078	0.0031	0.0044	0.0051
<b>H</b> Pre-hardened Steel (P20, Stavax) Die Cast Steels (A2, S7) Hardened Steels (D2)	40 - 43 HRC	655 (330 - 1150)		0.0059	0.0027	0.0031	0.0039
	43 - 48 HRC	590 (295 - 1150)		0.0059	0.0024	0.0027	0.0027
	50 - 55 HRC	495 (330 - 985)	0.0039	0.0024	0.0027	0.0027	

## Theoretical Cusp Height

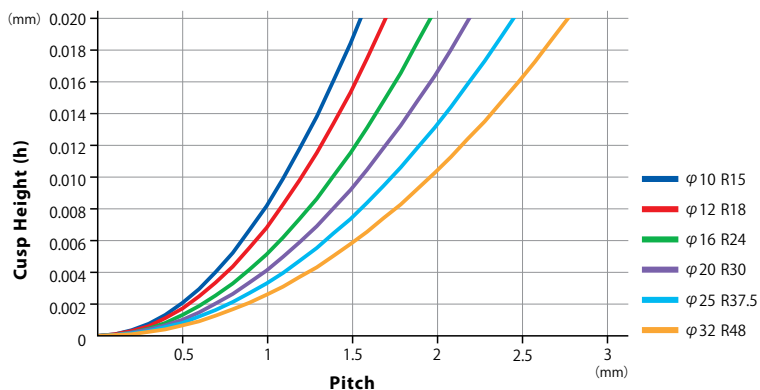
**PFB-BR**  
Barrel Type Tool



**PFB-LZ**  
Lens Type Tool



**Cusp Height and Pitch**



$$h = 0.5 \times (2 \times RE2 - \sqrt{(2 \times RE2)^2 - P^2})$$

h: Cusp Height P: Pitch RE2: Peripheral Edge R

## Recommended Materials by Application

Insert Grade	P	M	K	N	S	H
XP3225	⊙	○			○	
XP3310			⊙			⊙

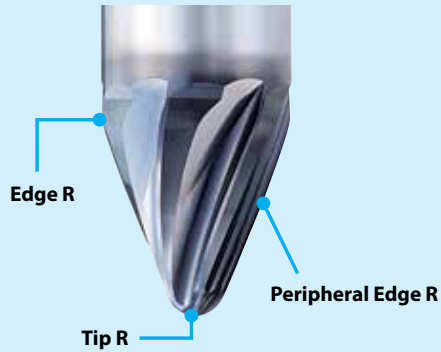
○ good ⊙ best

## VU-TBR Features & Benefits

Achieves Greater Processing Efficiency By the Large Peripheral Edge Radius and Multi-Flute Specification

### VU-TBR

Taper Barrel Type

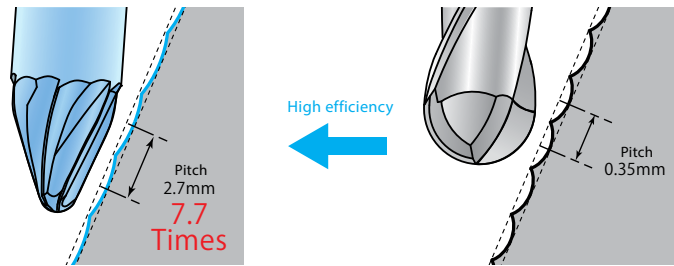


- Contour milling of vertical slope
- 20° tool tilt angle

#### Multi-Flute Specification for Higher Processing Efficiency

#### Highly Efficient Finishing

With the Same Cusp Height (0.003mm)



The large Peripheral edge R allows the cusp height to be kept at a minimum level even when the pitch is increased.

## VU-TBR Cutting Data

### High Efficiency 5-Axis Machining On Vertical Slope

By increasing the pitch with a large radius and increasing the feed rate, approximately 10 times the efficiency is achieved.

Tool	VU-TBR	Conventional Ball End Mill
Size	R1.5 x R300 x 20°	R5
No. of Flutes	4	2
Work Material	NAK80 (40 HRC)	
Cutting Speed	765 SFM (11937 RPM)	925 SFM (9549 RPM)
Feed	37.6 IPM (0.0008 in/t)	30.1 IPM (0.0016 in/t)
Pitch	0.1063 in	0.0134 in
Depth of Cut	0.0118 in	0.0118 in
Cusp Height	0.0001 in	
Overhang	1.378 in	
Surface Roughness	Ra = 0.12 μm Rz = 1.39 μm	Ra = 0.61 μm Rz = 2.59 μm
Coolant	Air	
Machine	5-Axis MC	

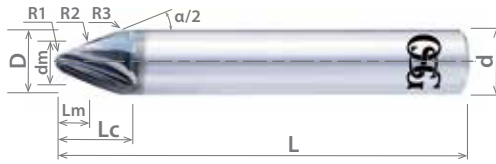
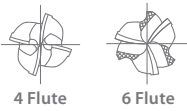


## List 3785

VU-TBR, Multiple Flute, Taper Barrel

<b>NEW</b>	<b>SPEED FEED</b> P16-17	<b>CARBIDE</b>	<b>WXL</b>		<b>15°</b>	<b>SHANK</b> h5	<b>SHRINK</b> FIT
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Form Tolerance	
$6 \leq D \leq 16$	+0.010mm / -0.010mm



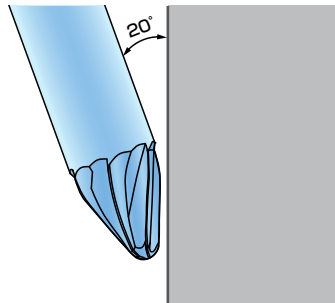
Units: mm

EDP	Tilt Angle	Mill Diameter	Tip Radius	Peripheral Edge Radius	Edge Radius	Length to Center of Radius	Diameter at Center of Radius	Overall Length	Length of Cut	Shank Diameter	No. of Flutes
	$\alpha/2$	D	R1	R2	R3	Lm	dm	L	Lc	d	
8549544	20°	6	0.5	150	5	3.43	3.27	50	8.2	6	4
8549545	20°	8	1	150	5	4.48	4.78	60	9.9	8	4
8549546	20°	10	1.5	300	5	5.52	6.2	70	11.7	10	4
8549547	20°	12	2	300	5	6.57	7.7	80	13.5	12	6
8549548	20°	16	2.5	500	5	8.99	10.18	100	18	16	6
8549549	20°	16	3	500	5	8.67	10.62	100	17.1	16	6

Packed: 1 pc.  
Available WXL coating only.



Note: When using the peripheral edge R (R2), set the tilt angle ( $\alpha/2$ ) to 20°.



List No.	Work Material															
	P					M			K	N		S	H			
	Carbon Steels			Alloy Steels	Die Steels	Stainless Steels $\leq 200\text{HB}$			Cast Iron	Aluminum		Nickel Alloy	Titanium	Hardened Steels		
	Low	Med.	High			300	400	17-4 PH			6061	Casting	Inconel	6Al4V (30 HRC)	~35 HRC	35-45 HRC
3785	⊙	⊙	⊙	⊙									⊙	⊙	⊙	

⊙ good ⊙ best



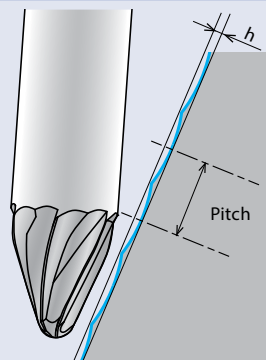
### List 3785: EXOCARB VU-TBR: Taper Barrel, Multiple Flute

Hardness	< 30 HRC			30 - 45 HRC			45 - 55 HRC		
Work Material	Carbon Steel Alloy Steel			Hardened Steel Prehardened Steel			Hardened Steel Prehardened Steel		
Cutting Speed	360 SFM			300 SFM			230 SFM		
Depth of Cut	Aa = 0.012"			Aa = 0.012"			Aa = 0.012"		
Mill Dia.	Speed RPM	Feed in/min	Pitch	Speed RPM	Feed in/min	Pitch	Speed RPM	Feed in/min	Pitch
6 (R0.5 x R150 x 20°)	10700	133.9	Based on cusp height (See chart below)	8800	98.5	Based on cusp height (See chart below)	6800	63	Based on cusp height (See chart below)
8 (R1 x R150 x 20°)	7300	90.6		6000	67		4700	43.4	
10 (R1.5 x R300 x 20°)	5600	70.9		4600	51.2		3600	35.5	
12 (R2 x R300 x 20°)	4500	86.7		3700	63		2900	39.4	
16 (R2.5 x R500 x 20°)	3400	63.0		2800	47.3		2200	31.5	
16 (R3 x R500 x 20°)	3300	63.0	2700	43.4	2100	31.5			

1. This chart should be used when machining with the Peripheral Edge Radius, R2.
2. Use a rigid and precise machine and holder.
3. Use a coolant with low air-blow or fuming property according to the work material. MQL (oil mist coolant) is recommended for cutting hardened steels.
4. Using Peripheral Edge Radius (R2) is the guide to use the intermediate position of peripheral edge radius. Please adjust the rotation speed, feed rate and cutting pitch based on the cutting shape, machine rigidity, workpiece and holding conditions.
5. When chattering, vibration or abnormal cutting noise occurs, please adjust the rotation speed, feed rate and cutting pitch.
6. In order to change the rotation speed, both the rotation speed and the feed rate should be changed at the same ratio.

### Theoretical Cusp Height

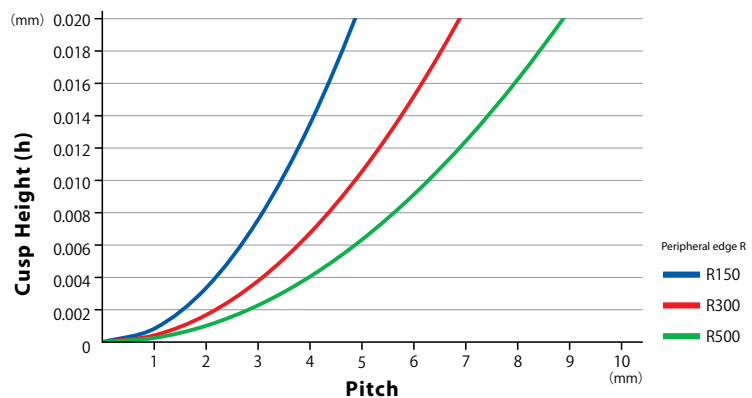
**VU-TBR**  
Taper Barrel Type



$$h = 0.5 \times (2 \times RE2 - \sqrt{(2 \times RE2)^2 - P^2})$$

h: Cusp Height P: Pitch RE2: Bottom Edge R

**Cusp Height and Pitch**



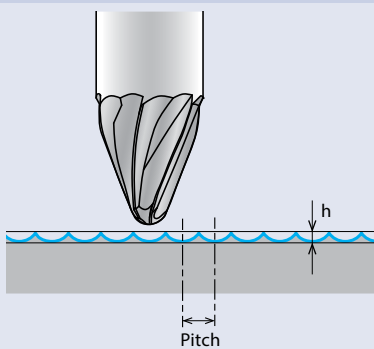


Hardness	< 30 HRC			30 - 45 HRC			45 - 55 HRC		
Work Material	Carbon Steel Alloy Steel			Hardened Steel Prehardened Steel			Hardened Steel Prehardened Steel		
Cutting Speed	660 SFM			525 SFM			460 SFM		
Depth of Cut	D=6 Aa = 0.004" D=8 Aa = 0.008" D=10 Aa = 0.010" D≥12 Aa = 0.012"			D=6 Aa = 0.004" D=8 Aa = 0.008" D=10 Aa = 0.010" D≥12 Aa = 0.012"			D=6 Aa = 0.004" D=8 Aa = 0.008" D=10 Aa = 0.010" D≥12 Aa = 0.012"		
Mill Dia.	Speed RPM	Feed in/min	Pitch	Speed RPM	Feed in/min	Pitch	Speed RPM	Feed in/min	Pitch
6 (R0.5 x R150 x 20°)	19500	244.1	Based on cusp height (See chart below)	15600	173.3	Based on cusp height (See chart below)	13600	130.0	Based on cusp height (See chart below)
8 (R1 x R150 x 20°)	13300	169.3		10700	118.2		9300	86.7	
10 (R1.5 x R300 x 20°)	10300	130.0		8200	90.6		7200	67.0	
12 (R2 x R300 x 20°)	8300	157.5		6600	110.3		5800	82.7	
16 (R2.5 x R500 x 20°)	6300	118.2		5000	82.7		4400	63.0	
16 (R3 x R500 x 20°)	6000	114.2		4800	78.8		4200	59.1	

1. This chart should be used when machining with the Tip Radius, R1.
2. Use a rigid and precise machine and holder.
3. Use a coolant with low air-blow or fuming property according to the work material. MQL (oil mist coolant) is recommended for cutting hardened steels.
4. Using Tip Radius (R1) is the guide to use the tip radius. Please adjust the rotation speed, feed rate and cutting pitch based on the cutting shape, machine rigidity, workpiece and holding conditions.
5. When chattering, vibration or abnormal cutting noise occurs, please adjust the rotation speed, feed rate and cutting pitch.
6. In order to change the rotation speed, both the rotation speed and the feed rate should be changed at the same ratio.

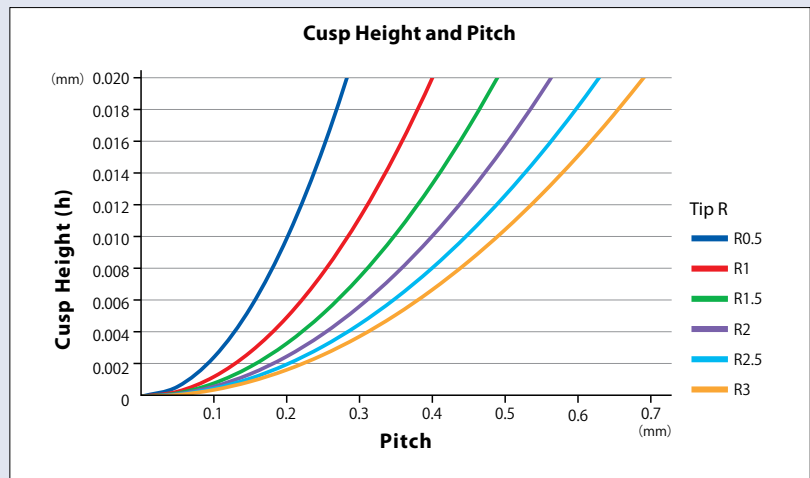
## Theoretical Cusp Height

**VU-TBR**  
Taper Barrel Type



$$h = 0.5 \times (2 \times RE1 - \sqrt{(2 \times RE1)^2 - P^2})$$

h: Cusp Height P: Pitch RE1: Tip R



PAT.P in JAPAN

## Features & Benefits

Can Be Utilized Like Any Ball Nose End Mill

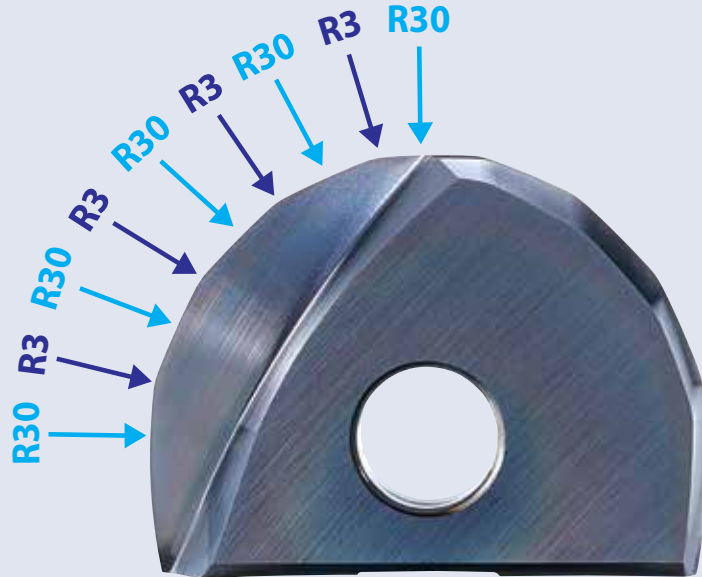
# PolyBall

Can be used just like any ball end mill.

Improves machined surface quality and reduces machining time for complex shapes such as inclined and curved surfaces.

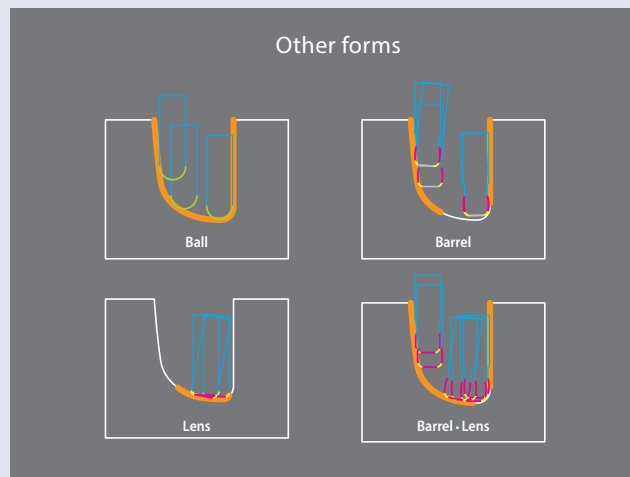
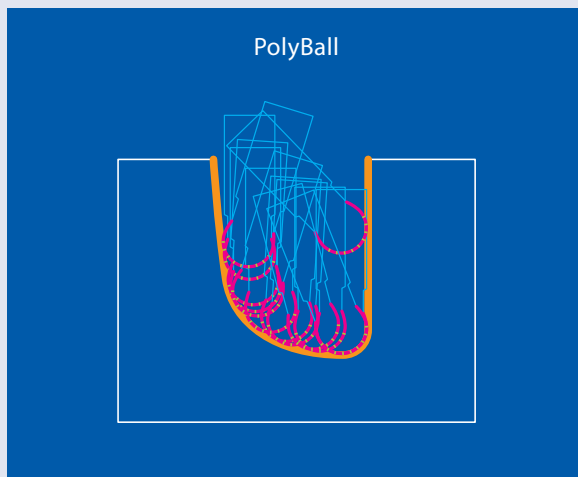


Even with the same  $\varnothing 20$  tool, a typical ball end mill would have a R10-edge whereas the PolyBall is constructed with a R30-edge. As a result, the cusp height can be kept small even if the pitch becomes larger, enabling high precision machining in shorter time.



Example of combination of Rs.

## Compatible with Various Inclined Surfaces



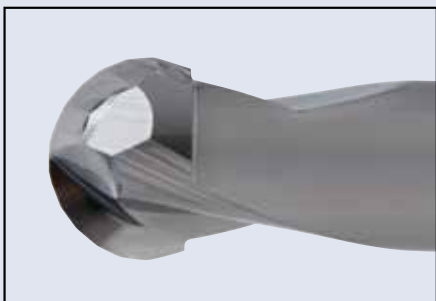
Machined area

## PFB PolyBall Specials Capability

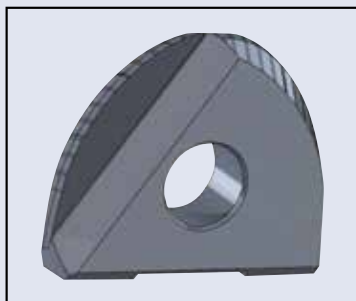
Tailored special tools are available to accommodate specific machining requirement. Please contact your sales representative for details.

## Cutting Data

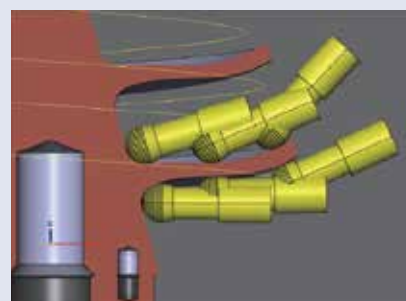
### Impeller Machining with Solid & Indexable PolyBall



**Solid PolyBall**  
φ12 R60-R1.2

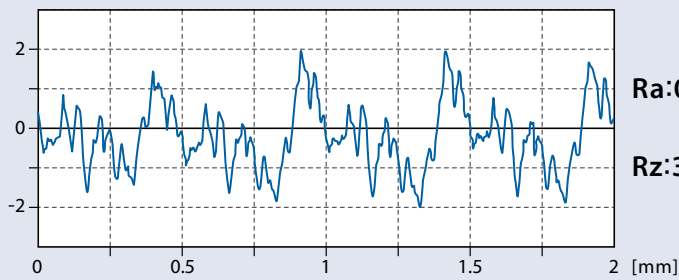


**PFB PolyBall**  
φ12 R24-R1.2



Work Material	A7075 T651
Machine	5-Axis MC
Coolant	Non Water-Soluble

Process	Tool	Cutting Method	Cutting Speed	Feed	Depth of Cut	Overhang Length	Stock to Leave
1	CA-PKE	Roughing	1607 SFM (13000 RPM)	315.0 IPM (0.0083 in/t)	Aa = 0.059 in Ar = 0.315 in	2.559 in	0.016 in 0.008 in
2	<b>Solid PolyBall</b> Ø12 R60-R6	Semi-Finishing of Blade Face & Edge	1040 SFM (8400 RPM)	118.1 IPM (0.007 in/t)	Pitch = 0.157 in Aa = 0.079 in	1.575 in	0.004 in
3	<b>PFB PolyBall</b> Ø12 R24-R6	Finishing of Blade Face	1358 SFM (11000 RPM)	66.9 IPM (0.003 in/t)	Pitch = 0.019 in Aa = 0.019 in	1.653 in	—
4	DLC-EBD R4	Semi-Finishing of Blade Edge, Hub Face & Fillet	656 SFM (8000 RPM)	94.5 IPM (0.0059 in/t)	Pitch = 0.027 in Aa = 0.019 in	1.653 in	0.006 in
5	DLC-EBD R4	Finishing of Blade Edge, Hub Face & Fillet	656 SFM (8000 RPM)	94.5 IPM (0.0059 in/t)	Pitch = 0.007 in Aa = 0.007 in	1.653 in	—





*shaping your dreams*

 **Safe use of cutting tools**

- Use safety cover, safety glasses and safety shoes during operation.
- Do not touch cutting edges with bare hands.
- Do not touch cutting chips with bare hands. Chips will be hot after cutting.
- Stop cutting when the tool becomes dull.
- Stop cutting operation immediately if you hear any abnormal cutting sounds.
- Do not modify tools.
- Please use appropriate tools for the operation. Check dimensions to ensure proper selection.

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