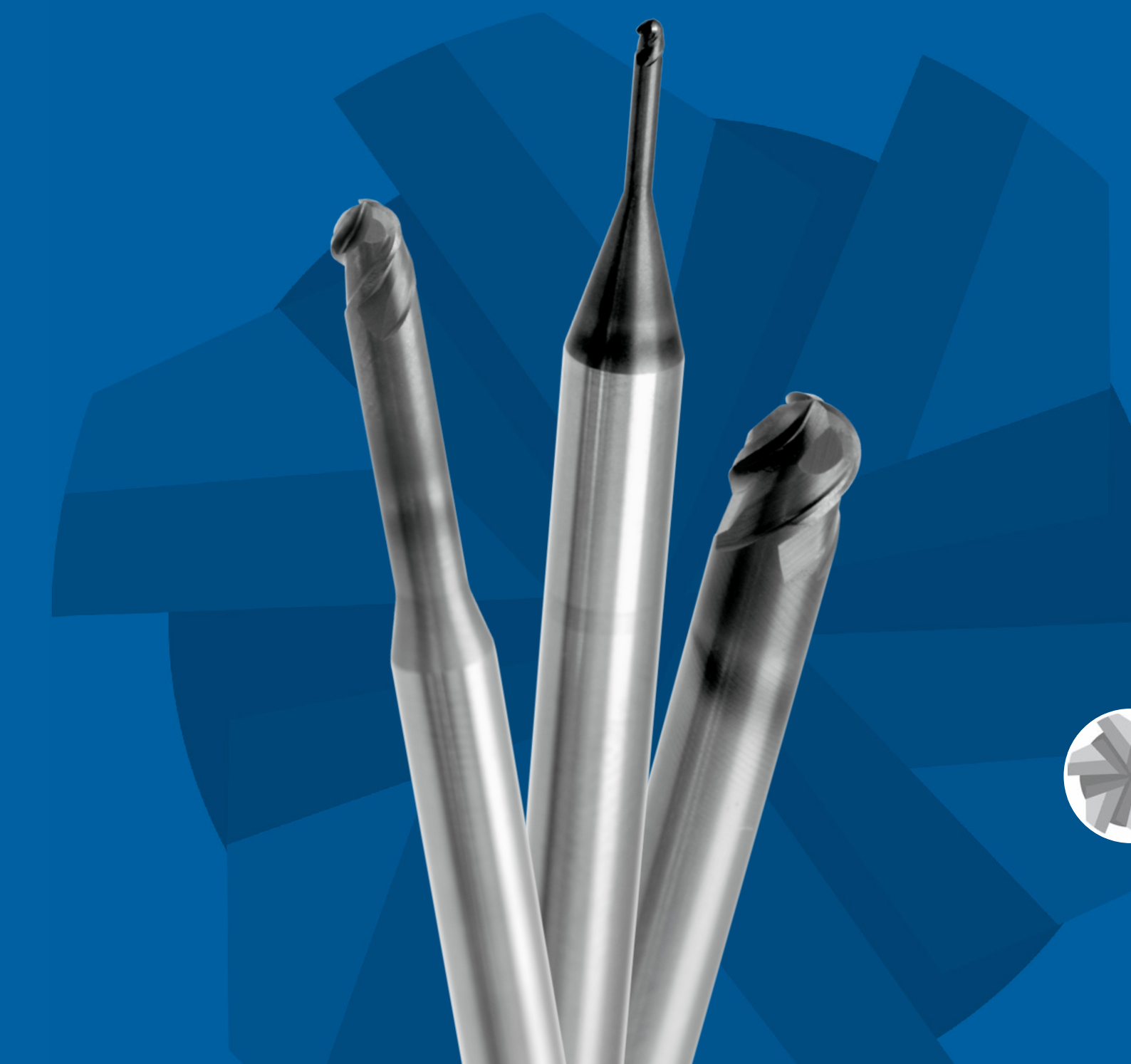
Long-neck & Bull nose end mills

PHX SERIES

PHX-LN-DBT PHX-LN-CRE PHX-DFR PHX-LN-DFR PHX-PG-DFR
PHX-CRT PHX-DBT PHX-PG-DBT



PHX End Mill Series

Key features PHX-LN-DBT

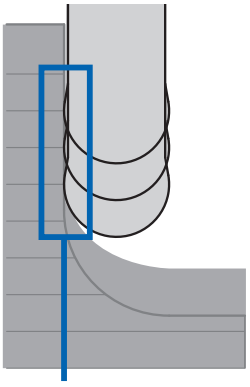
Time required for roughing can be greatly reduced with the PHX long neck ball nose end mill!

1 Short length of cut

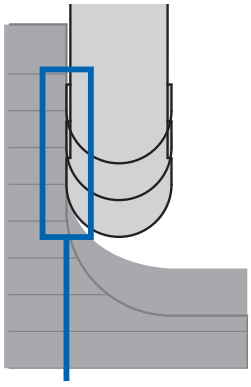
Highly rigid 0.75D short length of cut geometry enables low resistance vertical wall milling.

2 Improved accuracy in vertical wall milling

Without back taper, the PHX-LN-DBT's peripheral cutting edge is able to achieve flat milling to improve accuracy.



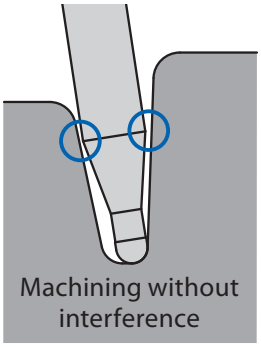
Peripheral cutting edge with back taper



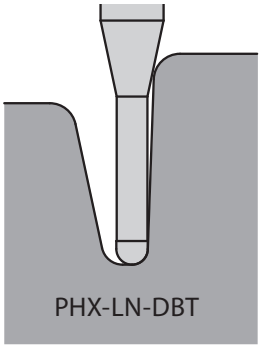
Peripheral cutting edge without back taper

3 Slim neck shape

Performs particularly well in five-axis milling with neck length limitation.

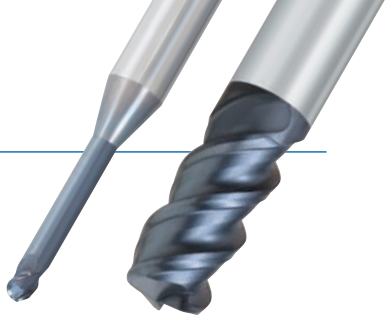


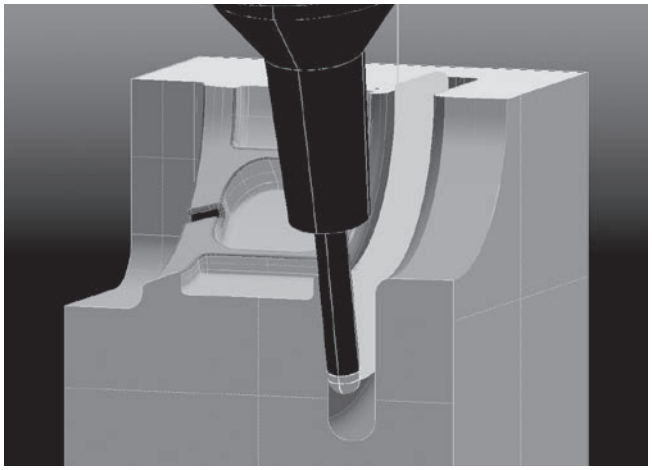
Machining without interference



PHX-LN-DBT

Example in five-axis machining

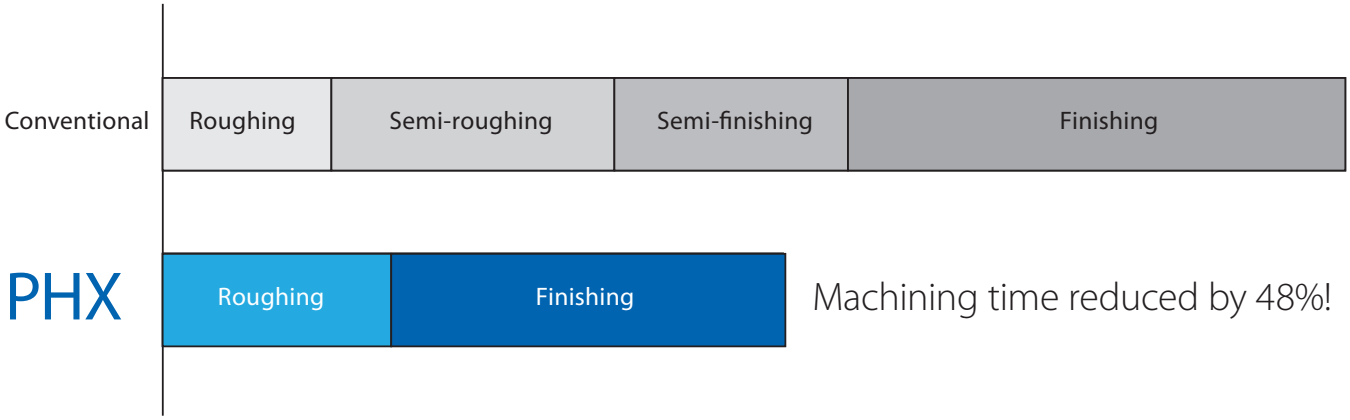




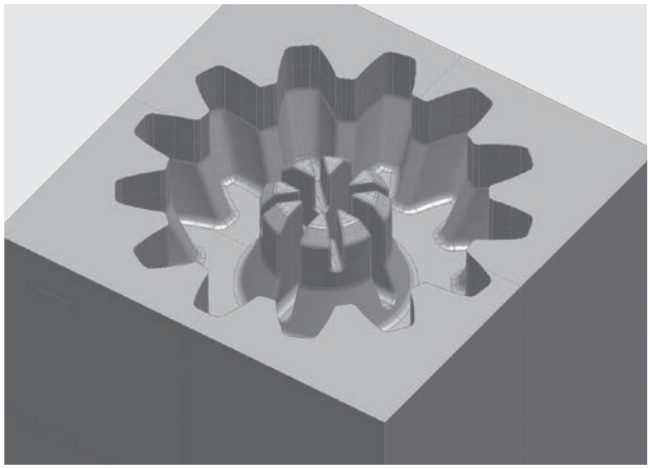
Work size	50×50×50mm
Work Material	NAK80 40HRC
Machine	Five-axis Machining Center
Main Spindle	HSK A63
Coolant	Air Blow
Maximum RPM	18,000 min^{-1}
Holder	Shrink Fit

Process	Milling Process	Tool	Length	(min^{-1}) Speed	(mm/min) Feed	(mm) ap	(mm) pf	(mm) Remnants	(m) Milling Length	Milling Time
1	Contour roughing (pink)	PHX-DFR 10×R2	25.0	3,800	2,100	0.50	2.50	0.1	15.4	0:07:16
2	Side finish milling (pink)	↓	25.0	3,800	600	-	2.40	0	376.0	0:00:50
3	Contour roughing (green)	↓	25.0	2,400	2,100	0.50	2.50	0.05	20.1	0:08:37
4	Fixed inclined-axis surface milling (green)	↓	25.0	3,800	1,000	-	0.20	0	8.9	0:10:42
5	Contour surface roughing (blue)	PHX-LN-DBT R2×20	23.0	7,600	1,550	0.25	1.00	0.01	17.5	0:13:46
6	Contour surface finish milling (blue)	↓	23.0	5,500	1,350	0.12	0.10	0	16.2	0:10:40
7	Contour surface roughing (cyan)	PHX-LN-DBT R1.5×12	14.0	12,000	1,700	0.30	0.70	0.05	14.0	0:09:26
8	Contour surface finish milling (cyan)	↓	14.0	11,000	2,050	0.09	0.10	0	9.5	0:04:31
9	Circumferential surface finish milling (cyan)	↓	14.0	11,000	2,050	-	0.08	0	5.4	0:02:49
10	Surface milling (rounded corners)(cyan)	↓	14.0	11,000	2,050	-	0.08	0	5.4	0:03:12
11	Milling of remaining areas (cyan)	PHX-LN-DBT R0.75×6	13.0	16,000	960	0.04	0.04	0	18.4	0:24:54
12	Contour surface roughing (gray)	PHX-LN-DBT R0.5×4	12.0	18,000	1,000	0.05	0.16	0	9.0	0:09:45
13	Contour surface finish milling (gray)	↓	12.0	18,000	900	-	0.03	0	339.0	0:00:29

Tool operation time 1:46:57



Machining data

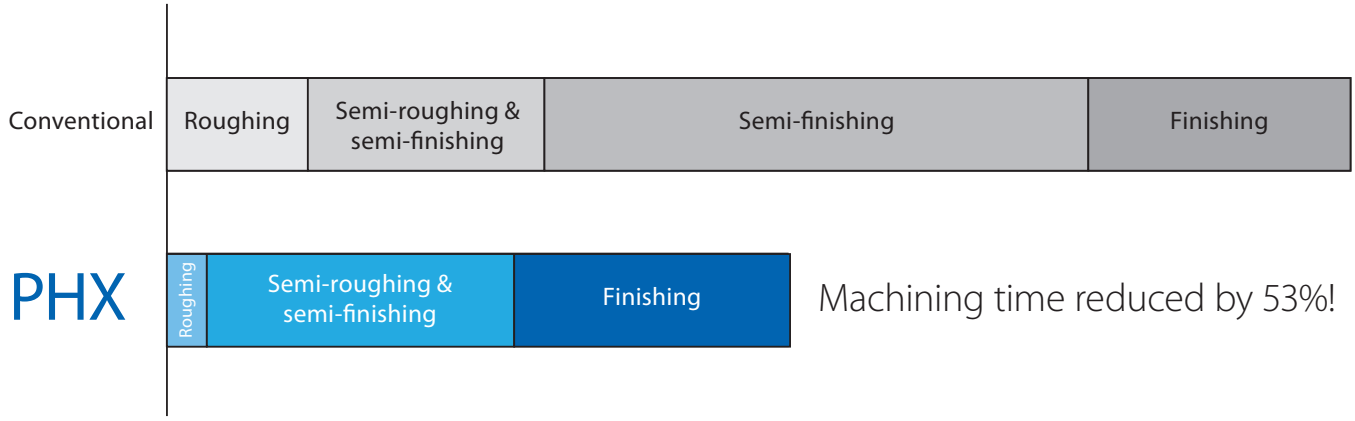


Work size	50×50×50mm
Work Material	NAK80 40HRC
Machine	Five-axis Machining Center
Main Spindle	HSK A63
Coolant	Air Blow
Maximum RPM	18,000 min^{-1}
Holder	Shrink Fit

Process	Milling Process	Tool	Length	(min^{-1}) Speed	(mm/min) Feed	(mm) ap	(mm) pf	(mm) Remnants	(m) Milling Length	Milling Time
1	3D Arbitrary Stock Roughing	PHX-LN-DBT R3×20	22	8,000	4,500	0.50	1.5	0.1	10.1	0:06:27
2	Arbitrary Stock Roughing	PHX-LN-DBT R1×12	20	12,000	1,200	0.15	0.8	0.05	28.3	0:43:19
3[1]	3D Complate Machining	↓	20	12,000	1,200	-	0.4	0.05	782.0	
4	3D Z-Level Finishing	↓	20	12,000	2,000	0.12	-	0	33.4	0:31:31
5	3D Plofile Finishing	↓	20	12,000	2,000	-	0.12	0	4.4	
6	3D Rest Machining	↓	20	12,000	2,000	0.12	0.12	0	2.5	
7	3D Z-Level Finishing	PHX-LN-DBT R0.5×6	15	12,000	600	0.06	-	0	8.3	0:36:58
8	3D Z-Level Finishing	↓	15	12,000	800	0.06	-	0	6.7	
9	3D Plofile Finishing	↓	15	12,000	800	-	0.06	0	433.0	

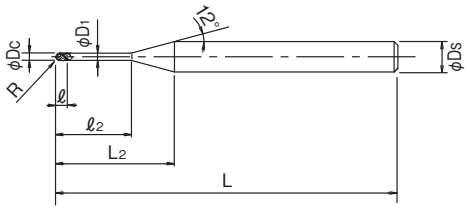
[1] For flat surface milling

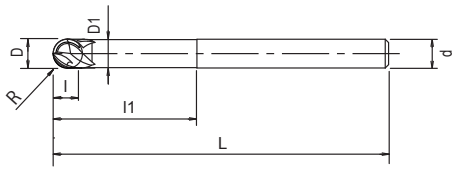
Tool operation time 1:58:15



Machining time reduced by 53%!

PHX-LN-DBT NEW SIZES





Phoenix Long Neck Ball Nose End Mill

- Tool Material: Micro Grain Carbide
- Surface Treatment: WX Super Coating
- Helix Angle: 45°
- Tolerance of Ball Nose Radius: ± 0.007mm
- Tolerance for Outer Diameter: ± 0.007mm

Unit: mm

EDP No,	Z	R×ℓ2	L2	L	ℓ	Ds	D1	θk	*1		Type
									0,5°	1°	
3194901	3	R 0,3 × 1	9,1	50	0,45	4	0,55	11,02	1,03	1,06	1
3194902		R 0,3 × 2	10,1					9,92	2,07	2,15	
3194903		R 0,3 × 3	11,1					9,01	3,12	3,24	
3194904		R 0,3 × 4	12,1					8,25	4,16	4,33	
3194906		R 0,3 × 6	14,1					7,07	6,24	6,51	
NEW SIZES W1504436	3	R 0,4 × 1	8,8	50	0,6	4	0,75	11,09	1,03	1,06	1
NEW SIZES W1504437		R 0,4 × 2	9,8					9,91	2,07	2,15	
NEW SIZES W1504438		R 0,4 × 3	10,8					8,95	3,11	3,24	
NEW SIZES W1504439		R 0,4 × 4	11,8					8,16	4,15	4,32	
NEW SIZES W1504440		R 0,4 × 6	13,8					6,94	6,24	6,51	
3195004	3	R 0,5 × 4	11,2	50	0,75	4	0,95	8,06	4,15	4,31	1
3195006		R 0,5 × 6	13,2					6,8	6,24	6,49	
3195008		R 0,5 × 8	15,2					5,87	8,32	8,67	
3195010		R 0,5 × 10	17,2					5,17	10,41	10,85	
3195012		R 0,5 × 12	19,2					4,62	12,49	13,03	
3195014		R 0,5 × 14	21,2					4,17	14,58	15,21	
3195016		R 0,5 × 16	23,2					3,8	16,66	17,39	
3195106	3	R0,75 × 6	12	50	1,13	4	1,45	6,38	6,22	6,47	1
3195108		R0,75 × 8	14					5,42	8,31	8,65	
3195110		R0,75 × 10	16					4,71	10,4	10,83	
3195112		R0,75 × 12	18					4,17	12,48	13,01	
3195116		R0,75 × 16	22					3,38	16,65	17,36	
3195206	3	R 1 × 6	11	50	1,5	4	1,95	5,85	6,21	6,45	1
3195208		R 1 × 8	13					4,87	8,3	8,63	
3195210		R 1 × 10	15					4,16	10,39	10,81	
3195212		R 1 × 12	17					3,64	12,47	12,98	
3195214		R 1 × 14	19					3,23	14,56	15,16	
3195216		R 1 × 16	21					2,9	16,64	17,34	
3195218		R 1 × 18	23	60				2,64	18,73	19,52	
3195220		R 1 × 20	25					2,41	20,81	21,7	
3195222		R 1 × 22	27					2,23	22,9	23,88	
3195312	3	R 1,5 × 12	14,5	60	2,25	4	2,85	2,22	12,45	12,94	1
3195316		R 1,5 × 16	18,5					1,7	16,62	17,3	
3195320		R 1,5 × 20	22,5					1,37	20,79	21,66	
3195325		R 1,5 × 25	27,5					1,11	26,01	27,1	
3195416	3	R 2 × 16	-	60	3	4	3,85	-	-	-	2
3195420		R 2 × 20	-								
3195425		R 2 × 25	-								
3195520	3	R 3 × 20	-	70	4,5	6	5,85	-	-	-	2
3195530		R 3 × 30	-								

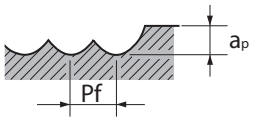
*1: Please see p. 9 for effective neck length (Le) based on the inclination angle (α) of workpiece.

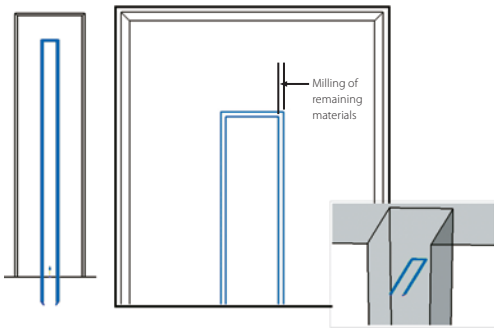
Recommended Milling Conditions

Work Material			~40HRC High feed roughing of free-cutting materials				Vibration control condition												
							40~60HRC Semi-roughing in high toughness mold materials				~60HRC Machining conditions for slotting				~60HRC Machining conditions for finishing				
			Hardened Steel • Prehardened Steel																
			SKT4 • SKD61 • NAK80 • HPM1 • DH** SCM • S40C~S60C • CoCrMo				DH** • DAC** • ZHD** • SKD61 • SKD11 • Ti-6Al-4V(H) • CoCr • SKT4 • NAK80 • HPM** • SCM**												
R	ℓ2	Recommended Cutting Angle	Speed (min^{-1})	Feed (mm/min)	Depth of Cut (mm)		Speed (min^{-1})	Feed (mm/min)	Depth of Cut (mm)		Speed (min^{-1})	Feed (mm/min)	Depth of Cut (mm)		Speed (min^{-1})	Feed (mm/min)	Depth of Cut (mm)		Clearance (mm)
					a_p	Pf			a_p	Pf			a_p	Last Pitch *1			a_p	Pf	
R0.3	1	0.3°	18,000	1,200	0.06	0.14	18,000	1,000	0.05	0.1	18,000	300	0.05	0.05	18,000	700	0.018	0.018	0.03
	2		18,000	1,000	0.05	0.12	18,000	850	0.04	0.1	18,000	255	0.04	0.05	18,000	700	0.018	0.018	0.03
	3		18,000	850	0.04	0.12	18,000	700	0.03	0.08	18,000	210	0.03	0.04	18,000	700	0.018	0.018	0.025
	4		18,000	700	0.03	0.1	18,000	600	0.025	0.08	18,000	180	0.025	0.04	18,000	700	0.018	0.018	0.02
	6		18,000	500	0.02	0.09	16,000	400	0.02	0.06	16,000	120	0.02	0.03	16,000	620	0.018	0.018	0.01
R0.4	1	0.3°	18,000	1,050	0.05	0.16	18,000	850	0.05	0.15	18,000	250	0.05	0.05	18,000	700	0.024	0.024	0.03
	2		18,000	1,050	0.05	0.16	18,000	850	0.05	0.15	18,000	250	0.05	0.05	18,000	700	0.024	0.024	0.03
	3		18,000	900	0.04	0.16	18,000	700	0.04	0.15	18,000	200	0.04	0.05	18,000	700	0.024	0.024	0.03
	4		18,000	750	0.03	0.14	18,000	600	0.03	0.14	18,000	180	0.03	0.04	18,000	700	0.024	0.024	0.02
	6		18,000	700	0.02	0.14	18,000	400	0.02	0.14	18,000	120	0.02	0.04	18,000	700	0.024	0.024	0.02
R0.5	4	0.3°	18,000	1,200	0.08	0.2	18,000	1,100	0.07	0.16	18,000	330	0.07	0.07	18,000	900	0.03	0.03	0.05
	6		18,000	1,000	0.05	0.16	18,000	900	0.05	0.16	18,000	270	0.05	0.07	18,000	900	0.03	0.03	0.05
	8		16,000	800	0.04	0.16	16,000	700	0.04	0.16	16,000	210	0.04	0.05	16,000	720	0.03	0.03	0.03
	10		12,000	650	0.04	0.16	10,000	550	0.03	0.15	10,000	160	0.03	0.05	12,000	540	0.03	0.03	0.03
	12		8,000	420	0.03	0.15	8,000	420	0.03	0.15	–	–	–	–	8,000	360	0.03	0.03	0.02
	14		7,000	350	0.02	0.13	7,000	350	0.02	0.13	–	–	–	–	7,000	320	0.03	0.03	0.02
	16		6,000	260	0.01	0.1	6,000	260	0.01	0.1	–	–	–	–	6,000	270	0.02	0.02	0.01
R0.75	6	0.3°	18,000	1,500	0.1	0.3	16,000	1,300	0.1	0.23	16,000	390	0.1	0.1	18,000	1,100	0.04	0.04	0.05
	8		16,000	1,300	0.08	0.3	16,000	1,150	0.08	0.23	16,000	340	0.08	0.1	16,000	960	0.04	0.04	0.05
	10		15,000	1,100	0.06	0.25	15,000	950	0.06	0.23	15,000	280	0.06	0.1	15,000	900	0.04	0.04	0.03
	12		10,000	700	0.04	0.2	10,000	600	0.03	0.2	10,000	180	0.03	0.1	10,000	600	0.04	0.04	0.02
	16		7,500	400	0.025	0.15	7,500	400	0.02	0.15	7,500	120	0.02	0.07	10,000	600	0.04	0.04	0.01
R1	6	0.3°	18,000	1,600	0.2	0.6	15,000	1,400	0.2	0.3	15,000	420	0.2	0.1	15,000	1,800	0.06	0.05	0.1
	8		14,000	1,400	0.18	0.5	14,000	1,200	0.15	0.3	14,000	360	0.15	0.1	12,000	1,500	0.06	0.05	0.07
	10		12,000	1,250	0.16	0.4	12,000	1,100	0.12	0.3	12,000	330	0.12	0.1	12,000	1,500	0.06	0.05	0.07
	12		10,000	1,050	0.14	0.4	10,000	900	0.1	0.3	10,000	300	0.1	0.1	10,000	1,200	0.06	0.05	0.07
	14		8,000	850	0.12	0.35	8,000	700	0.08	0.3	8,000	240	0.08	0.1	8,000	1,000	0.06	0.05	0.05
	16		7,500	780	0.12	0.4	7,500	650	0.07	0.25	7,500	260	0.07	0.07	7,500	950	0.06	0.05	0.03
	18		6,800	700	0.1	0.4	6,800	630	0.06	0.2	6,800	250	0.06	0.07	6,800	700	0.06	0.05	0.03
	20		6,200	650	0.1	0.4	6,200	600	0.05	0.2	6,200	240	0.05	0.05	6,200	600	0.06	0.05	0.02
	22		6,000	600	0.08	0.3	6,000	450	0.05	0.15	6,000	180	0.05	0.05	6,000	550	0.06	0.05	0.02
R1.5	12	0.3°	12,000	1,700	0.3	0.7	8,000	1,200	0.25	0.5	8,000	480	0.25	0.15	11,000	2,050	0.09	0.08	0.1
	16		10,000	1,550	0.25	0.7	8,000	1,200	0.2	0.5	8,000	480	0.2	0.15	10,000	1,900	0.09	0.08	0.07
	20		7,500	1,150	0.2	0.6	7,200	1,100	0.2	0.5	7,200	440	0.2	0.15	7,500	1,400	0.09	0.08	0.07
	25		4,800	750	0.18	0.6	4,600	700	0.18	0.5	4,600	280	0.18	0.15	4,800	900	0.09	0.08	0.05
R2	16	0.5°	9,300	1,900	0.27	1	6,000	1,200	0.27	0.8	6,000	480	0.27	0.2	9,000	2,250	0.12	0.1	0.1
	20		7,600	1,550	0.25	1	6,000	1,150	0.25	0.8	6,000	450	0.25	0.2	8,200	2,050	0.12	0.1	0.1
	25		6,100	1,250	0.23	0.8	5,500	1,100	0.23	0.6	5,500	420	0.23	0.2	5,500	1,350	0.12	0.1	0.07
R3	20	0.5°	8,000	3,000	0.43	1.5	4,000	1,200	0.3	1	4,000	480	0.3	0.2	8,000	1,800	0.18	0.16	0.1
	30		5,100	1,500	0.34	1.2	4,000	1,150	0.3	1	4,000	480	0.3	0.2	5,100	1,150	0.18	0.16	0.07

*1. The "Last Pitch" is the standard final contour pitch value calculated based on slotting and pocket milling paths including runout and overcut caused by lateral cutting forces.

1. The above cutting conditions based on overhang length are to be used as general guideline. Adjustments may be necessary depending on actual milling condition.
2. Overhang cutting conditions based on the effective length of the tool attached to the holder.
3. Highly rigid machines and tool holders should be used.
4. Tool vibrations should be kept at a minimum level for maximum accuracy.
5. In the case of linear machining, do not use the Pf value, instead refer to the ap value.
6. More stable high-feed machining in the corners can be attained by setting an R insertion or deceleration on the CAM or machine side.
7. When cutting load fluctuates (in the corners, etc.) or when high precision is required, be sure to control the rotational speed.
8. When cutting at greater than the recommended cutting angle, reduce the feed.
9. When the depth of cut is less than the specified amount as listed above, the feed rate can be increased up to 150%.
10. When the depth of cut is greater than the specified amount as listed above, the feed rate can be reduced by no more than 60% to ensure stable milling.





In comparison to radius end mills, ball end mills machine less materials per pass. In order to improve the precision of the ribs, please separate the roughing and finishing procedures.

Key features PHX-LN-CRE

4-flute Long Neck Small Bull Nose End Mill

1 The corner radius shape provides both cutting force and cutting edge rigidity.

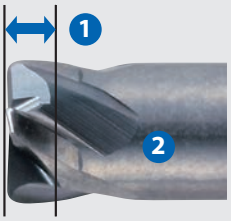
2 Radial and end edge configurations suppress the generation of chattering vibration.

3 Special edge lines prevent biting.

4 An ideal chip pocket for superior chip evacuation.

1. Lenght of cut
2. Short flute lenght
3. Unequal spacing

PHX-LN-CRE



conventional

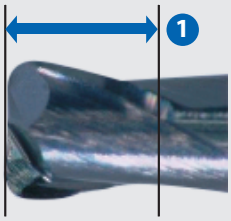
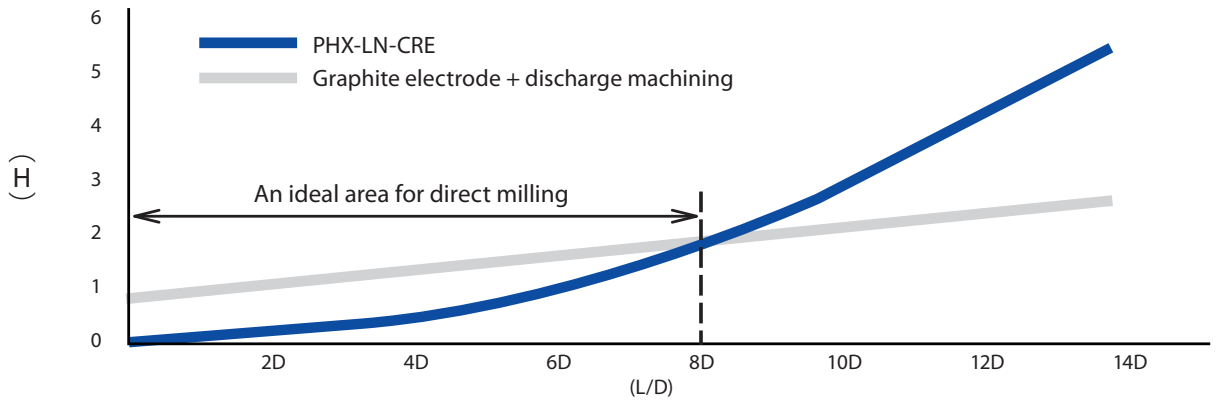


photo of end edge

A map for effective machining



This graph is the image graph of 1.5mm wide 40mm long flute dimension.

Machining data

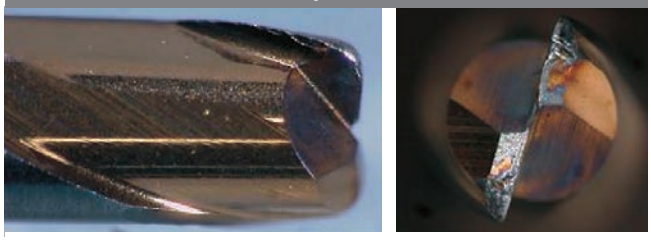
Lib operation on plastic mold.
A special designed tool for slot milling on high hardness steel as STAVAX(52HRC)

- A special tool for easy direct milling operations
- A special cutting edge design enabled a stable operation
- Capable even on shallow flute milling with ultra high speed

Tool	PHX-LN-CRE φ1×R0.2 ×6
Work Material	STAVAX (52HRC)
Milling Method	Lib Groove Operation
Cutting Speed	63m/min (20,000min^{-1})
Feed	840mm/min (0.0105mm/t)
Depth of Cut	ap=0.02mm
Coolant	Air Blow
Machine	Vertical Machining Center
Milling Length	120m

PHX-LN-CRE

Competitor

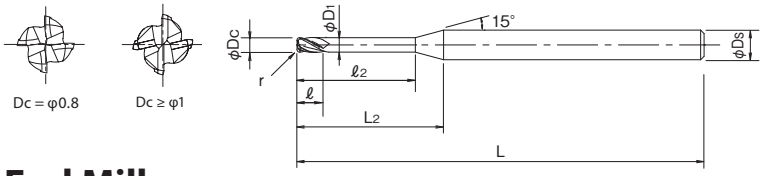


High precision machining on HPM38 (53HRC) with gear shape

- From semi-finish to finishing operation
- Capable with high feed rate even at narrow area

Tool	PHX-LN-CRE φ2×R0.5×10
Work Material	HPM38 (53HRC)
Milling Method	Countour Line Operation
Cutting Speed	113m/min (18,000min^{-1})
Feed	2,500mm/min (0.035mm/t)
Depth of Cut	ap=0.1mm ae=0.8mm
Coolant	Air Blow
Machine	Vertical Machining Center
Milling Length	80m

PHX-LN-CRE



4-flute Long Neck Small Bull Nose End Mill

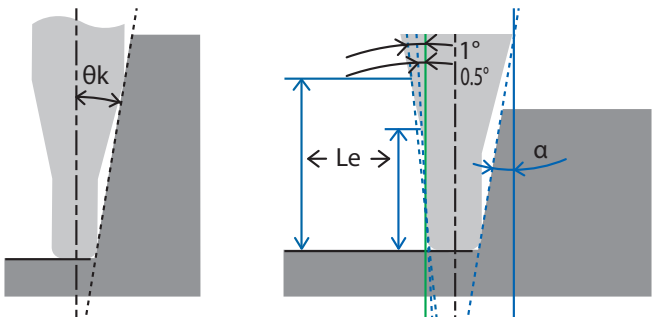
- Tool Material: Micro Grain Carbide
- Surface Treatment: WX Super Coating
- Helix Angle: Dc = 0.8 54˚, Dc ≥ 1 30˚
- Tolerance of Radius: ± 0.007mm
- Tolerance for Outer Diameter: 0~- 0.0015mm
- Neck Length Tolerance: 0~0.1mm

Unit: mm

EDP No.	Dc×r×ℓ2	L2	L	ℓ	Ds	D1	θk	(Le)*1		Z	Stock	Euro
								0.5°	1°			
3190800	0.8 × R0.1 × 2	8.1	50	0.32	4	0.72	11.48	2.06	2.13	4	●	
3190801	0.8 × R0.1 × 4	10.1					9.2	4.13	4.27			
3190802	0.8 × R0.1 × 6	12.1					7.67	6.2	6.41			
3190803	0.8 × R0.1 × 8	14.1					6.58	8.27	8.55			
3191006	1 × R0.1 × 4	9.7	50	0.4	4	0.93	8.97	4.13	4.27	4	●	
3191007	1 × R0.1 × 6	11.7					7.43	6.2	6.41			
3191008	1 × R0.1 × 8	13.7					6.34	8.27	8.55			
3191009	1 × R0.1 × 10	15.7					5.53	10.33	10.69			
3191010	1 × R0.1 × 12	17.7					4.9	12.4	12.83			
3191011	1 × R0.2 × 4	9.7					9.05	4.13	4.26			
3191012	1 × R0.2 × 6	11.7					7.49	6.2	6.4			
3191013	1 × R0.2 × 8	13.7					6.38	8.26	8.54			
3191014	1 × R0.2 × 10	15.7					5.56	10.33	10.68			
3191015	1 × R0.2 × 12	17.7					4.93	12.4	12.82			
3191018	1 × R0.3 × 4	9.7					9.14	4.12	4.26			
3191019	1 × R0.3 × 6	11.7					7.55	6.19	6.4			
3191501	1.5 × R0.1 × 4	8.8	50	0.6	4	1.41	8.3	4.13	4.27	4	●	
3191503	1.5 × R0.1 × 8	12.8					5.68	8.27	8.55			
3191505	1.5 × R0.1 × 12	16.8					4.31	12.4	12.83			
3191506	1.5 × R0.2 × 4	8.8					8.39	4.13	4.26			
3191507	1.5 × R0.2 × 6	10.8					6.8	6.2	6.4			
3191508	1.5 × R0.2 × 8	12.8					5.72	8.26	8.54			
3192001	2 × R0.1 × 8	12.1	50	0.8	4	1.89	4.91	8.27	8.55	4	●	
3192002	2 × R0.1 × 10	14.1					4.19	10.33	10.69			
3192003	2 × R0.1 × 12	16.1					3.66	12.4	12.83			
3192004	2 × R0.1 × 16	20.1					2.92	16.54	17.11			
3192013	2 × R0.3 × 8	12.1					4.99	8.26	8.54			
3192015	2 × R0.3 × 12	16.1					3.71	12.39	12.82			
3192019	2 × R0.5 × 6	10.1					6.16	6.19	6.38			
3192020	2 × R0.5 × 8	12.1					5.08	8.25	8.52			
3192021	2 × R0.5 × 10	14.1					4.32	10.32	10.66			
3192022	2 × R0.5 × 12	16.1					3.75	12.39	12.8			
3193008	3 × R0.3 × 12	14.2	50	1.2	4	2.85	2.11	12.39	12.82	4	●	

*1: Please see p. 9 for effective neck length (Le) based on the inclination angle (α) of workpiece.

● Delivery from stock
○ Available on short notice



No numerical value means no interference with the workpiece.

Recommended Milling Conditions

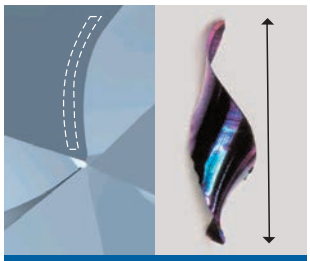
Work Material			Lib Groove Milling								Contour Line Finish Milling		
			Slotting				Contour Offset						
			CENA1 STAVAX HPM38 SKD61 42~55HRC										
Dc	r	ℓ	Speed (min^{-1})	Feed (mm/min)	Depth of Cut		Speed (min^{-1})	Feed (mm/min)	Depth of Cut		Speed (min^{-1})	Feed (mm/min)	Depth of Cut
					a_p	a_e			a_p	a_e			a_e
0.8	0.1	2	18,000	720	0.02	0.2	18,000	930	0.02	0.2	18,000	1,150	0.015
		4	18,000	720	0.02	0.2	18,000	930	0.02	0.2	18,000	1,150	0.015
		6	18,000	720	0.02	0.2	18,000	930	0.02	0.2	18,000	1,150	0.015
		8	15,000	540	0.013	0.2	15,000	630	0.013	0.2	16,000	700	0.013
1	0.1	4	18,000	830	0.03	0.23	18,000	880	0.03	0.23	18,000	1,440	0.015
		6	18,000	830	0.024	0.23	18,000	880	0.024	0.23	18,000	1,440	0.015
		8	15,000	750	0.013	0.23	15,000	800	0.013	0.23	15,000	1,200	0.015
		10	12,000	300	0.007	0.2	12,000	400	0.007	0.2	12,000	960	0.015
		12	10,500	220	0.006	0.18	10,500	288	0.006	0.18	10,500	840	0.015
1	0.2	4	18,000	830	0.03	0.23	18,000	880	0.03	0.23	18,000	1,440	0.018
		6	18,000	830	0.024	0.23	18,000	880	0.024	0.23	18,000	1,440	0.018
		8	15,000	750	0.013	0.23	15,000	800	0.013	0.23	15,000	1,200	0.018
		10	12,000	300	0.007	0.2	12,000	400	0.007	0.2	12,000	960	0.018
		12	10,500	220	0.006	0.18	10,500	290	0.006	0.18	10,500	840	0.018
1	0.3	4	18,000	830	0.03	0.23	18,000	1,000	0.03	0.23	18,000	1,440	0.022
		6	18,000	830	0.024	0.23	18,000	890	0.024	0.23	18,000	1,440	0.022
1.5	0.1	4	16,000	1,230	0.03	0.34	16,000	1,300	0.03	0.34	18,000	1,620	0.015
		8	16,000	1,230	0.026	0.34	16,000	1,300	0.026	0.34	18,000	1,620	0.015
		12	10,000	480	0.013	0.3	10,000	750	0.013	0.3	10,000	900	0.015
1.5	0.2	4	16,000	1,230	0.03	0.34	16,000	1,300	0.03	0.34	18,000	1,620	0.018
		6	16,000	1,230	0.029	0.34	16,000	1,300	0.029	0.34	18,000	1,620	0.018
		8	16,000	1,230	0.026	0.34	16,000	1,300	0.026	0.34	18,000	1,620	0.018
2	0.1	8	12,000	1,300	0.03	0.46	12,000	1,760	0.03	0.46	18,000	1,620	0.015
		10	12,000	1,200	0.03	0.46	12,000	1,620	0.03	0.46	15,000	1,350	0.015
		12	12,000	1,150	0.024	0.46	12,000	1,320	0.024	0.46	13,000	1,170	0.015
		16	7,600	780	0.012	0.46	7,600	750	0.012	0.46	7,000	630	0.015
2	0.3	8	12,000	1,300	0.05	0.46	12,000	1,620	0.05	0.46	18,000	1,620	0.022
		12	12,000	1,150	0.04	0.46	12,000	1,320	0.04	0.46	13,000	1,170	0.022
2	0.5	6	12,000	1,300	0.08	0.45	12,000	1,760	0.08	0.45	18,000	1,620	0.025
		8	12,000	1,300	0.075	0.45	12,000	1,760	0.075	0.45	18,000	1,620	0.025
		10	12,000	1,200	0.07	0.45	12,000	1,620	0.07	0.45	15,000	1,350	0.025
		12	12,000	1,150	0.06	0.45	12,000	1,320	0.06	0.45	13,000	1,170	0.025
3	0.3	12	8,000	1,200	0.046	0.7	8,000	1,400	0.046	0.7	13,000	1,170	0.022

1. Adjust the speed, feed, and depth of cut in according to the operating conditions, including the machining shape, machine and, holder rigidity, and workholding force.
2. If the speed and feed rates cannot be increased due to equipment capability, operate by reducing the speed and feed rates at the same ratio.
3. High cutting speeds and feed rates can cause wear and/or reduce machining precision. Therefore, please reduce the feed as needed.
4. Chattering may occur depending on the shape of the part, which can damages. Reduce the speed and feed rate at the same ratio to avoid chattering.
5. For precise, detailed machining, use a dedicated machine that operates less chattering.
6. Keep the runout at the tip of the end mill below 0.005mm.
7. To perform finish machining with a high level of efficiency, keep the speed and feed rates below 2 times.
8. To finish a flat surface, vemain speed range in a minimal amount of equipment vibration and feed rate not causing the equipment to wobble.
9. To finish machining a curved surface using the corner radius of the tool, operate by changing the machining pitch.
10. Set the inclined cut angle between approximately 0.3° to 0.5°.
11. When the depth of cut is less than the specified amount as listed above, the feed rate can be increased up to 150%.
12. When the depth of cut is greater than the specified amount as listed above, the feed rate can be reduced by no more than 60% to ensure stable milling.

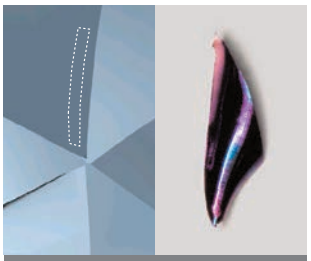
PHX Deep Feeder Bull Nose Series

- In addition to the negative shape of the conventional PHX-CRT high feeder bull nose, it achieves the thermolysis effect. The superior bull nose performs exceptionally well when making deep cuts that are ordinarily susceptible to chattering or when working in materials that are difficult to machine.
- The precision of the PHX-CRT high feeder bull nose is ± 0.01 mm, and the deep feeder bull nose series is ± 0.03 mm.
- Use the deep feeder bull nose series or the PHX-CRT high feeder bull nose to suit your radius precision requirements.

The Thermolysis Effects are:



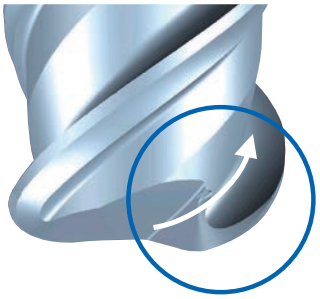
PHX-DBT



Standard Three Flute End Mill

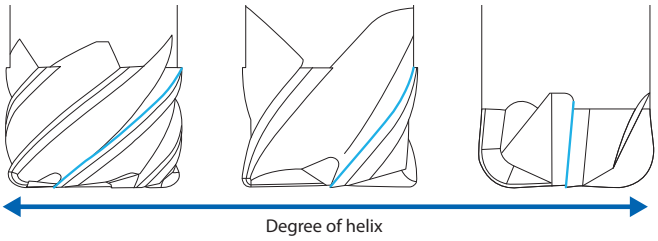
- Due to the strong spiral gash, the cutting edge becomes longer and thinner.
- It becomes easier to dissipate cutting heat and the cutting edge and workpiece are less effected by heat buildup.

A Three-Dimensional Negative Form is:

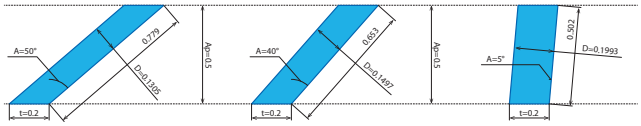


- A form where the weaker central portion of the cutting edge has a slight negative angle, and the easily broken outer portion has a strong negative angle.
- Designed for long tool life by increasing chip evacuation and reducing heat buildup.

Effect based on helix angle (comparison of cut length)



Ex. Images of cutting chips produced based on helix angle where the cutting length is 0.2 mm (t = 0.2 mm)
*Radius ignored



The above is strictly a conceptual analysis. Result may vary based on actual milling.

Even if are milling conditions identical, the volume of the cutting chips are the same, but the amount of resistance and heat released will differ based on the change in chip shape.

Use the deep feeder bull nose series to expand the scope of your mold milling work, and improve your productivity further more through high-precision roughing without chattering.

Three types of deep feeder bull nose series are available for a wide range of milling work.
- PHX-DFR - Standard shape
- PHX-LN-DFR - Long neck shape
- PHX-PC-DFR - Pencil neck shape

Overhang conversion table of the PHX-PC (Pencil Neck) Series

The following table is to calculate the new overhang length, since rigidity has been improved with the use of Pencil Neck. Please use below as a reference for your cutting condition.

Step 1. Overhang Length : Mill Diameter = L/D

Step 2. Overhang Length x Percentage = Converted overhang length for straight shank

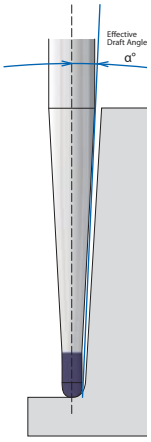
Ex.) PHX-PC-DBT R3 × 2˚ × 62.3, milling with an overhang of 65mm

Step 1. (Length x 65mm) : (Mill Diameter : φ6) = 10.83D -> Approximately 11D : confirm the percentage from the below table 11D and 2˚ (63.8%)

Step 2. (Length x 65mm) × (Percentage : 63.8%) = 41.47mm -> Based on this straight shank conversion, the overhang is calculated to be 45 mm. Please refer to it as the new cutting condition.

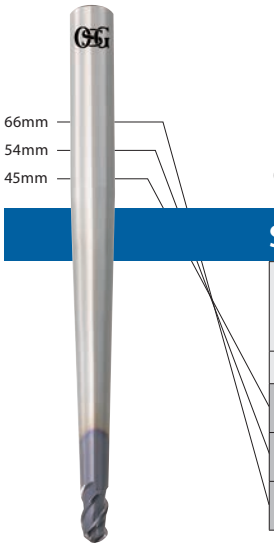
By utilizing the Pencil Neck, even if the overhang is 65 mm, the milling condition can be set equivalent to a 45mm straight shank tool while keeping the same rigidity.

Note: The above percentages are calculated based on the rigidity of the tool only. Please make necessary adjustments based on the conditions of your tool holder and machining center.



L/D / θn	3D	4D	5D	6D	7D	8D	9D	10D	11D	12D	13D	14D	15D	16D	20D
0.5˚	99.7%	98.3%	96.6%	95.2%	93.6%	92.1%	90.7%	89.3%	88.0%	86.7%	85.4%	84.1%	82.9%	81.8%	77.4%
1˚	98.3%	95.5%	92.6%	89.8%	87.1%	84.6%	82.2%	80.0%	77.9%	75.9%	74.0%	72.2%	70.5%	68.8%	62.9%
1.5˚	97.0%	93.0%	88.8%	85.2%	81.6%	78.4%	75.4%	72.7%	70.1%	67.7%	65.5%	63.4%	61.4%	59.6%	53.2%
2˚	95.7%	90.5%	85.6%	81.0%	76.9%	73.1%	69.8%	66.7%	63.8%	61.3%	58.8%	56.6%	54.6%	52.7%	46.2%

Please use this chart for sizes under 2˚ with low rigidity. For sizes over 2˚, please adjust accordingly based on milling condition.

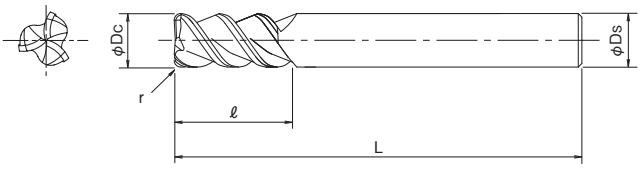


Even with a long overhang length, feed per cutting edge will not decrease. Single-neck type offers continuous machining with the same tool by simply changing the overhang length.

Semi-finishing process using PHX-PC-DBT (R3 × 1.5˚ × 43.2)

Overhang Length		Speed (min⁻¹)	Cutting Speed (m/min)	Feed (mm/min)	Feed per Tooth (mm/t)	Depth of Cut (mm)	
mm	L/D					ap	Pf
45	7.5	4,300	80	3,600	0.28	0.5	1.3
54	9	2,670	50	3,240	0.4	0.34	1
66	11	1,660	30	2,590	0.52	0.23	1

PHX-DFR



Phoenix Deep Feeder Bull Nose End Mill

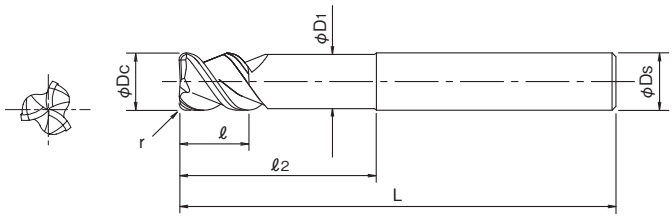
- Tool Material: Micro Grain Carbide
- Surface Treatment: WX Super Coating
- Helix Angle: 55˚
- Tolerance of Radius: ± 0.03mm
- Tolerance for Outer Diameter: 0.01mm

Unit: mm

EDP No.	Dc×r	L	ℓ	Ds	Z	Stock	Euro
3090512	6 × R1.5	80	12	6	3	○	
3090516	8 × R2	90	16	8	3	○	
3090520	10 × R2	100	20	10	3	○	
3090522	12 × R2	120	24	12	3	○	
3090526	16 × R3	130	32	16	3	○	
3090530	20 × R3	150	40	20	3	○	

● Delivery from stock
○ Available on short notice

PHX-LN-DFR



Phoenix Long Neck Deep Feeder Bull Nose End Mill

- Tool Material: Micro Grain Carbide
- Surface Treatment: WX Super Coating
- Helix Angle: 55˚
- Tolerance of Radius: ± 0.03mm
- Tolerance for Outer Diameter: 0.01mm

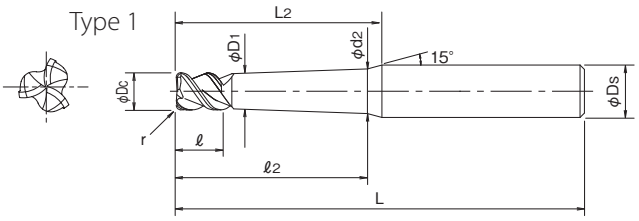
Unit: mm

EDP No.	Dc×r×ℓ2	L	ℓ	Ds	D1	Z	Stock	Euro
3092041	4 × R1 × 20	70	6	4	3.8	3	○	
3092042	4 × R1 × 28							
3092061	6 × R1.5 × 30	80	9	6	5.8	3	○	
3092062	6 × R1.5 × 42	90						
3092063	6 × R1.5 × 54	100						
3092081	8 × R2 × 40	85	12	8	7.7	3	○	
3092082	8 × R2 × 56	100						
3092083	8 × R2 × 72	120						
3092101	10 × R2 × 50	100	15	10	9.7	3	○	
3092102	10 × R2 × 70	120						
3092103	10 × R2 × 90	140						
3092121	12 × R2 × 60	110	18	12	11.7	3	○	
3092122	12 × R2 × 84	135						
3092123	12 × R2 × 108	160						
3092161	16 × R3 × 80	140	24	16	15.5	3	○	
3092162	16 × R3 × 120	175						

● Delivery from stock
○ Available on short notice

PHX-PC-DFR

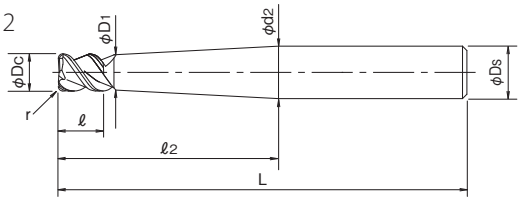
Type 1



Phoenix Pencil Neck Deep Feeder Bull Nose End Mill

- Tool Material: Micro Grain Carbide
- Surface Treatment: WX Super Coating
- Helix Angle: 55˚
- Tolerance of Radius: ± 0.03mm
- Tolerance for Outer Diameter: 0~- 0.015mm

Type 2

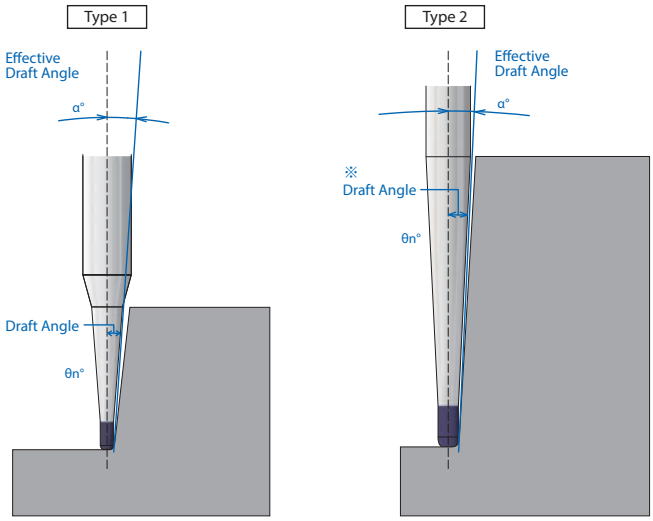


Unit: mm

EDP No.	α	Dc×r×θn×ℓ2	L2	L	ℓ	Ds	D1	d2	Z	Type	Stock	Euro
3097223	0.36°	2 × R0.5 × 0.5° × 20	27.7	60				2.25				
3097224	0.39°	2 × R0.5 × 0.5° × 25	32.6	70				2.33				
3097225	0.41°	2 × R0.5 × 0.5° × 30	37.4					2.42				
3097226	0.42°	2 × R0.5 × 0.5° × 35	42.2	80				2.51				
3097227	0.43°	2 × R0.5 × 0.5° × 40	47.1					2.6				
3097241	0.59°	2 × R0.5 × 1° × 10	17.8					2.19				
3097242	0.73°	2 × R0.5 × 1° × 15	22.5	60				2.37				
3097243	0.8°	2 × R0.5 × 1° × 20	27.1					2.54		1		
3097244	0.84°	2 × R0.5 × 1° × 25	31.8	70	3	6	1.95	2.72	3		○	
3097245	0.87°	2 × R0.5 × 1° × 30	36.5					2.89				
3097246	0.89°	2 × R0.5 × 1° × 35	41.2	80				3.07				
3097247	0.9°	2 × R0.5 × 1° × 40	45.8					3.24				
3097248	0.91°	2 × R0.5 × 1° × 45	50.5	100				3.42				
3097249	0.92°	2 × R0.5 × 1° × 50	55.2					3.59				
3097251	1.37°	2 × R0.5 × 1.5° × 40	44.6	80				3.89				
3097262	1.92°	2 × R0.5 × 2° × 60.3	-	100				6		2		
3097273	2.81°	2 × R0.5 × 3° × 41.2	-									
3097321	0.25°	3 × R0.8 × 0.5° × 20	26					3.17				
3097341	0.66°	3 × R0.8 × 1° × 20	25.5					3.44				
3097342	0.73°	3 × R0.8 × 1° × 25	30.1	80				3.62				
3097343	0.78°	3 × R0.8 × 1° × 30	34.8					3.79		1		
3097344	0.83°	3 × R0.8 × 1° × 40	44.2		4.5	6	2.9	4.14	3		○	
3097345	0.87°	3 × R0.8 × 1° × 50	53.5					4.49				
3097346	0.89°	3 × R0.8 × 1° × 60	62.9					4.84				
3097356	1.43°	3 × R0.8 × 1.5° × 60.8	-	100				6		2		
3097365	1.88°	3 × R0.8 × 2° × 46.5	-									
3097374	2.74°	3 × R0.8 × 3° × 32.1	-									
3097421	0.28°	4 × R1 × 0.5° × 25	29					4.23				
3097422	0.31°	4 × R1 × 0.5° × 30	33.9					4.32				
3097423	0.34°	4 × R1 × 0.5° × 35	38.7	80				4.41				
3097424	0.36°	4 × R1 × 0.5° × 40	43.5					4.49				
3097425	0.38°	4 × R1 × 0.5° × 45	48.4					4.58		1		
3097426	0.39°	4 × R1 × 0.5° × 50	53.2	100	6	6	3.9	4.67	3		○	
3097441	0.73°	4 × R1 × 1° × 30	33	80				4.74				
3097442	0.8°	4 × R1 × 1° × 40	42.4					5.09				
3097443	0.84°	4 × R1 × 1° × 50	51.8	100				5.44				
3097444	0.95°	4 × R1 × 1° × 61.3	-					6		2		
3097453	1.39°	4 × R1 × 1.5° × 42.2	-	80								

● Delivery from stock
○ Available on short notice

PHX-PC-DFR



- The tool may be deflected and may interfere with the draft area depending on milling condition.
- For convenience, the Draft Angle(θn°) is shown the same as the Effective Draft Angle(α°), but actually it is different. (It does not interfere with the Effective Draft Angle(α°))

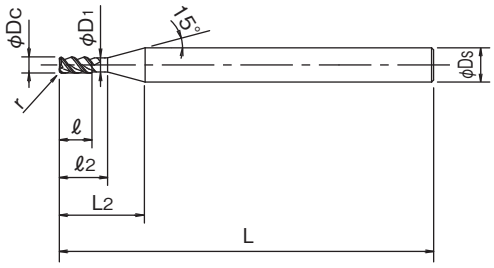
Unit: mm

EDP No.	α	Dc×r×θn×ℓ2	L2	L	ℓ	Ds	D1	d2	Z	Type	Stock	Euro
3097454	1.44°	4 × R1 × 1.5° × 80.4	-	120	6	8	3.9	8	3	2	○	
3097461	1.81°	4 × R1 × 2° × 32.6	-	80		6		6				
3097462	1.9°	4 × R1 × 2° × 61.3	-	120		8		8				
3097472	2.78°	4 × R1 × 3° × 42.2	-	100								
3097627	0.39°	6 × R1.5 × 0.5° × 60	63	130	9	8	5.9	6.79	3	1	○	
3097641	0.73°	6 × R1.5 × 1° × 40	42.6	100				6.98				
3097642	0.79°	6 × R1.5 × 1° × 50	51.9					7.33				
3097643	0.94°	6 × R1.5 × 1° × 62.3	-	130				8		2		
3097651	1.37°	6 × R1.5 × 1.5° × 43.2	-	100								
3097653	1.43°	6 × R1.5 × 1.5° × 81.4	-	130		10		10				
3097661	1.78°	6 × R1.5 × 2° × 33.6	-	100		8		8				
3097662	1.88°	6 × R1.5 × 2° × 62.3	-	130		10		10				
3097826	0.4°	8 × R2 × 0.5° × 80	82.6	150	12	10	7.9	9.09	3	1	○	
3097841	0.73°	8 × R2 × 1° × 50	52.3	120				9.23				
3097842	0.93°	8 × R2 × 1° × 63.3	-	150				10		2		
3097844	0.97°	8 × R2 × 1° × 120.6	-	180		12		12				
3097851	1.36°	8 × R2 × 1.5° × 44.2	-	120		10		10				
3097853	1.42°	8 × R2 × 1.5° × 82.4	-	150		12		12				
3097861	1.76°	8 × R2 × 2° × 34.6	-	120		10		10				
3097862	1.87°	8 × R2 × 2° × 63.3	-			12		12				
3098026	0.4°	10 × R2 × 0.5° × 100	102	150	15	12	9.9	11.38	3	1	○	
3098041	0.92°	10 × R2 × 1° × 64.3	-	120				12		2		
3098042	0.8°	10 × R2 × 1° × 80	88	160		16		12.17		1		
3098043	0.84°	10 × R2 × 1° × 100	106.7					12.87				
3098044	0.87°	10 × R2 × 1° × 120	125.4	180				13.57				
3098045	0.88°	10 × R2 × 1° × 140	144.1	200				14.26				
3098046	0.9°	10 × R2 × 1° × 160	162.7	220				14.96				
3098051	1.33°	10 × R2 × 1.5° × 45.2	-	120		12		12		2		
3098053	1.44°	10 × R2 × 1.5° × 121.6	-	180		16		16				
3098061	1.7°	10 × R2 × 2° × 35.6	-	120		12		12				
3098064	1.89°	10 × R2 × 2° × 92.9	-	220		16		16				
3098224	0.41°	12 × R2 × 0.5° × 120	125.2	180	18	16	11.9	13.68	3	1	○	
3098241	0.67°	12 × R2 × 1° × 60	65.8	120				13.37				
3098242	0.81°	12 × R2 × 1° × 100	103.2	180				14.76				
3098243	0.95°	12 × R2 × 1° × 122.6	-					16		2		
3098244	0.88°	12 × R2 × 1° × 160	166.7	220		20		16.86		1		
3098254	1.44°	12 × R2 × 1.5° × 160.8	-					20		2		

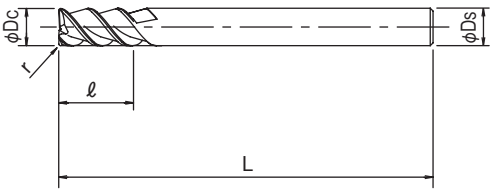
● Delivery from stock
○ Available on short notice

PHX-CRT

Type1



Type2



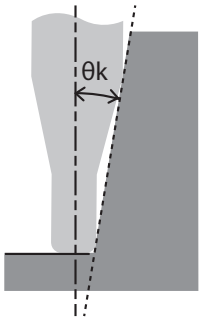
Phoenix High Feeder Bull Nose End Mill

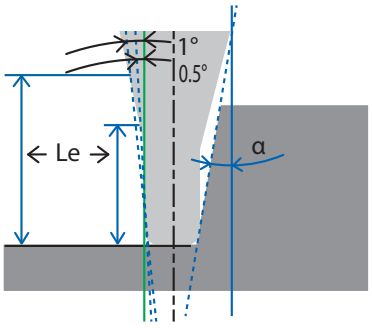
- Tool Material: Micro Grain Carbide
- Surface Treatment: FX TiAlN Coating
- Helix Angle: 55˚
- Tolerance of Radius: ± 0.01mm
- Tolerance for Outer Diameter:
  D ≤ 5 0~-0.015mm, D ≥ 6 0.01~-0.005mm

Unit: mm

EDP No.	Dc×r	ℓ2	L2	L	ℓ	Ds	D1	θk	(Le)*1		Z	Type	Stock	Euro
									0.5°	1°				
3090002	1 × R 0.3	4	13.9	60	2	6	0.95	10.84	4.12	4.26	3	1	○	
3090003	1.5 × R 0.3	4.5	12.9	60	3	6	1.45	10.11	4.64	4.79	3	1	○	
3090004	2 × R 0.5	6	14.0	60	4	6	1.95	8.74	6.19	6.38	3	1	○	
3090006	3 × R 0.8	9	14.9	70	6	6	2.85	6.19	9.28	9.57	3	1	○	
3090008	4 × R 1	12	16.1	70	8	6	3.85	3.87	12.37	12.77	3	1	○	
3090010	5 × R 1	15	17.2	70	10	6	4.85	1.8	15.47	15.98	3	1	○	
3090012	6 × R 1.5	-	-	80	12	6	-	-	-	-	3	2	○	
3090016	8 × R 2	-	-	90	16	8	-	-	-	-	3	2	○	
3090020	10 × R 2	-	-	100	20	10	-	-	-	-	3	2	○	
3090022	12 × R 2	-	-	120	24	12	-	-	-	-	3	2	○	
3090026	16 × R 3	-	-	130	32	16	-	-	-	-	3	2	○	
3090030	20 × R 3	-	-	150	40	20	-	-	-	-	3	2	○	

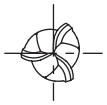
● Delivery from stock
○ Available on short notice



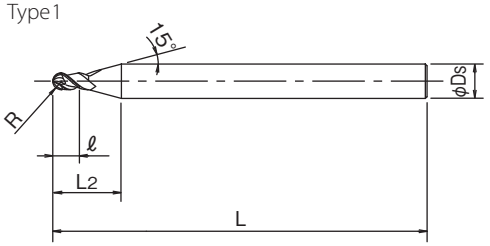


No numerical value means no interference with the workpiece.

PHX-DBT



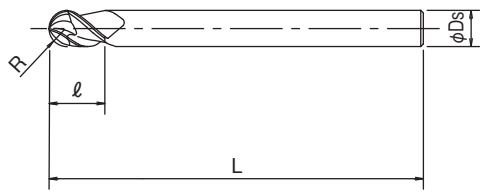
Type1



Phoenix Deep Feeder Ball Nose End Mill

- Tool Material: Micro Grain Carbide
- Surface Treatment: FX TiAlN Coating
- Helix Angle: 45˚
- Tolerance of Radius: ± 0.01mm
- Tolerance for Outer Diameter:
  D ≤ 5 0~-0.015mm, D ≥ 6 0.01~-0.005mm

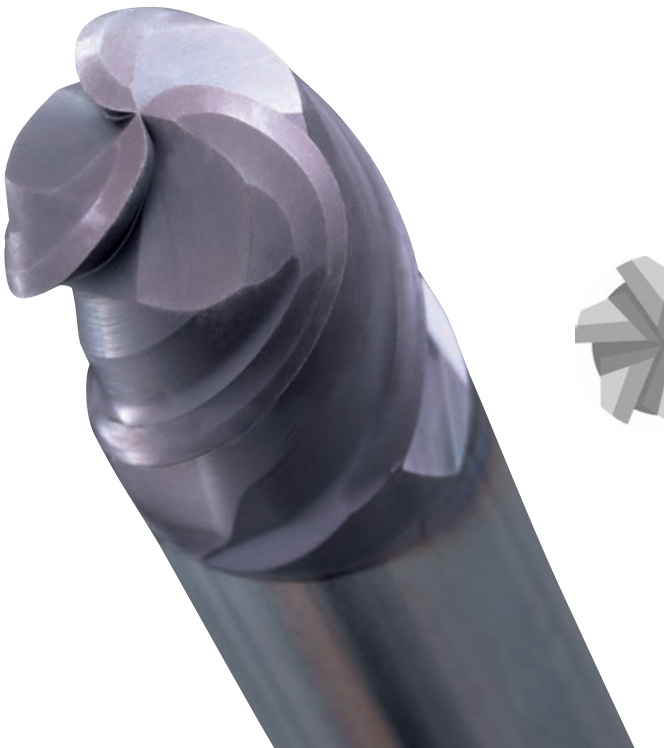
Type2



Unit: mm

EDP No.	R×L	L_2	ℓ	Ds	Z	Type	Stock	Euro
3090202	R 0.5 × 60	12	1.5	6	3	1	○	
3090204	R 1 × 60	12.3	3	6	3	1	○	
3090206	R 1.5 × 70	12.6	4.5	6	3	1	○	
3090208	R 2 × 70	12.2	6	6	3	1	○	
3090210	R 2.5 × 70	12.1	7.5	6	3	1	○	
3090212	R 3 × 80	-	9	6	3	2	○	
3090312	R 3 × 110	-						
3090216	R 4 × 90	-	12	8	3	2	○	
3090316	R 4 × 120	-						
3090220	R 5 × 100	-	15	10	3	2	○	
3090320	R 5 × 130	-						
3090222	R 6 × 100	-	18	12	3	2	○	
3090322	R 6 × 140	-						
3090226	R 8 × 150	-	24	16	3	2	○	
3090230	R 10 × 150	-	30	20	3	2	○	
3090330	R 10 × 200	-						

● Delivery from stock
○ Available on short notice



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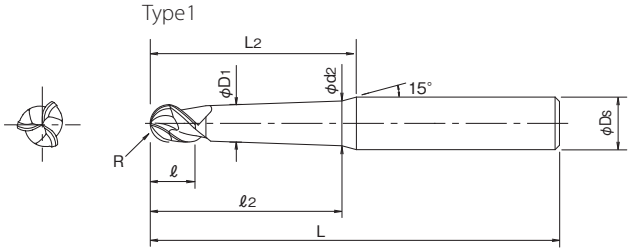
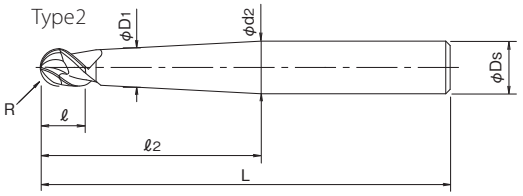




Phoenix Pencil Neck Deep Feeder Ball Nose End Mill

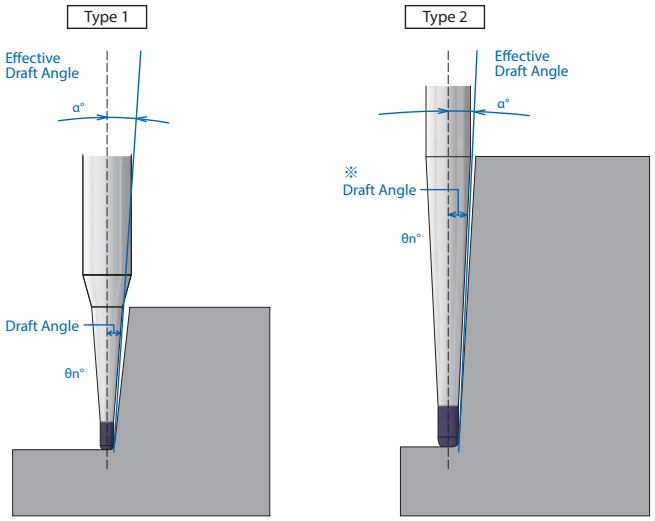
- Tool Material: Micro Grain Carbide
- Surface Treatment: WX Super Coating
- Helix Angle: 45˚
- Tolerance of Radius: ± 0.01mm
- Tolerance for Outer Diameter: 0~-0.015mm

Unit: mm

EDP No.	α	R×θn×ℓ2	L2	L	ℓ	Ds	D1	d2	Z	Type	Stock	Euro
3095125	0.38°	R0.5 × 0.5° × 16	25.6					1.2				
3095141	0.56°	R0.5 × 1° × 6	15.7					1.1				
3095142	0.68°	R0.5 × 1° × 8	17.6					1.17				
3095143	0.75°	R0.5 × 1° × 10	19.5	60				1.24				
3095144	0.79°	R0.5 × 1° × 12	21.4					1.31				
3095145	0.85°	R0.5 × 1° × 16	25.1		1.5	6	0.95	1.45	3	1	○	
3095146	0.88°	R0.5 × 1° × 20	28.8					1.59				
3095147	0.91°	R0.5 × 1° × 25	33.5	70				1.77				
3095155	1.3°	R0.5 × 1.5° × 15	23.7	60				1.65				
3095157	1.39°	R0.5 × 1.5° × 25	32.7	70				2.18				
3095191	4.3°	R0.5 × 4.5° × 30	31.6					5.43				
3095211	0.45°	R0.75 × 1° × 6	14.8					1.58				
3095212	0.65°	R0.75 × 1° × 9	17.6					1.68				
3095213	0.74°	R0.75 × 1° × 12	20.4	60	2.25	6	1.45	1.79	3	1	○	
3095214	0.8°	R0.75 × 1° × 15	23.2					1.89				
3095215	0.86°	R0.75 × 1° × 21	28.8					2.1				
3095216	0.9°	R0.75 × 1° × 30	37.3	70				2.41				
3095223	0.38°	R1 × 0.5° × 20	27.6					2.24				
3095241	0.62°	R1 × 1° × 10	17.7	60				2.19				
3095242	0.76°	R1 × 1° × 15	22.4					2.36				
3095243	0.82°	R1 × 1° × 20	27					2.54				
3095244	0.86°	R1 × 1° × 25	31.7	70				2.71		1		
3095245	0.89°	R1 × 1° × 30	36.4	80	3	6	1.95	2.89	3		○	
3095246	0.92°	R1 × 1° × 40	45.7					3.24				
3095247	0.93°	R1 × 1° × 50	55.1	100				3.59				
3095251	1.39°	R1 × 1.5° × 40	44.5	80				3.88				
3095262	1.93°	R1 × 2° × 60.3	-	100				6		2		
3095273	2.85°	R1 × 3° × 41.2	-	80								
3095281	3.94°	R1 × 4° × 30	-									
3095321	0.27°	R1.5 × 0.5° × 20	26					3.17				
3095341	0.69°	R1.5 × 1° × 20	25.5					3.44				
3095342	0.76°	R1.5 × 1° × 25	30.1	80				3.61				
3095343	0.8°	R1.5 × 1° × 30	34.8					3.79		1		
3095344	0.85°	R1.5 × 1° × 40	44.2		4.5	6	2.9	4.13	3		○	
3095345	0.88°	R1.5 × 1° × 50	53.5					4.48				
3095346	0.9°	R1.5 × 1° × 60	62.9	100				4.83				
3095356	1.45°	R1.5 × 1.5° × 60.8	-					6		2		
3095365	1.91°	R1.5 × 2° × 46.5	-									
3095374	2.8°	R1.5 × 3° × 32.1	-	80								
3095421	0.29°	R2 × 0.5° × 25	29					4.23				
3095441	0.76°	R2 × 1° × 30	33	80	6	6	3.9	4.73	3	1	○	
3095442	0.82°	R2 × 1° × 40	42.4					5.08				

● Delivery from stock
○ Available on short notice

PHX-PC-DBT



- The tool may be deflected and may interfere with the draft area depending on milling condition.
- For convenience, the Draft Angle(θn°) is shown the same as the Effective Draft Angle(α°), but actually it is different. (It does not interfere with the Effective Draft Angle(α°))

Unit: mm

EDP No.	α	R×θn×ℓ2	L2	L	ℓ	Ds	D1	d2	Z	Type	Stock	Euro
3095443	0.86°	R2 × 1° × 50	51.8	100	6	6	3.9	5.43	3	1	○	
3095444	0.97°	R2 × 1° × 61.3	-					6		2		
3095445	0.92°	R2 × 1° × 80	83.5	120		8		6.48		1		
3095453	1.42°	R2 × 1.5° × 42.2	-	80		6		6		2		
3095454	1.46°	R2 × 1.5° × 80.4	-	120		8		8				
3095462	1.93°	R2 × 2° × 61.3	-									
3095472	2.84°	R2 × 3° × 42.2	-	100								
3095541	0.76°	R2.5 × 1° × 35	39.7	100	7.5	8	4.9	5.86	3	1	○	
3095542	0.84°	R2.5 × 1° × 50	53.7					6.38				
3095543	0.89°	R2.5 × 1° × 70	72.4	130				7.08				
3095544	0.98°	R2.5 × 1° × 90.4	-					8		2		
3095553	1.45°	R2.5 × 1.5° × 61.8	-									
3095562	1.91°	R2.5 × 2° × 47.5	-									
3095641	0.77°	R3 × 1° × 40	42.6	100	9	8	5.9	6.98	3	1	○	
3095642	0.82°	R3 × 1° × 50	51.9					7.33				
3095643	0.97°	R3 × 1° × 62.3	-	130				8		2		
3095644	0.9°	R3 × 1° × 90	93.1			10		8.72		1		
3095651	1.42°	R3 × 1.5° × 43.2	-	100		8		8		2		
3095653	1.46°	R3 × 1.5° × 81.4	-	130		10		10				
3095661	1.87°	R3 × 2° × 33.6	-	100		8		8				
3095662	1.93°	R3 × 2° × 62.3	-	130		10		10				
3095841	0.77°	R4 × 1° × 50	52.3	120	12	10	7.9	9.22	3	1	○	
3095842	0.97°	R4 × 1° × 63.3	-					10		2		
3095843	0.88°	R4 × 1° × 90	93.4	150		12		10.62		1		
3095844	0.98°	R4 × 1° × 120.6	-	180				12		2		
3095851	1.42°	R4 × 1.5° × 44.2	-	120		10		10				
3095853	1.46°	R4 × 1.5° × 82.4	-	150		12		12				
3095862	1.93°	R4 × 2° × 63.3	-	120								
3096041	0.97°	R5 × 1° × 64.3	-	120	15	12	9.9	12	3	2	○	
3096042	0.83°	R5 × 1° × 80	88	160		16		12.16		1		
3096043	0.87°	R5 × 1° × 100	106.7	160				12.86				
3096044	0.89°	R5 × 1° × 120	125.4	180				13.56				
3096045	0.91°	R5 × 1° × 140	144.1	200				14.26				
3096046	0.92°	R5 × 1° × 160	162.8	220				14.96				
3096051	1.42°	R5 × 1.5° × 45.2	-	120		12		12		2		
3096053	1.47°	R5 × 1.5° × 121.6	-	180		16		16				
3096061	1.87°	R5 × 2° × 35.6	-	120		12		12				
3096064	1.95°	R5 × 2° × 92.9		160		16		16				
3096241	0.73°	R6 × 1° × 60	65.8	120	18	16	11.9	13.36	3	1	○	
3096242	0.85°	R6 × 1° × 100	103.2	180				14.76				
3096243	0.98°	R6 × 1° × 122.6	-					16		2		
3096244	0.91°	R6 × 1° × 160	166.7	220		20		16.85		1		
3096254	1.48°	R6 × 1.5° × 160.8	-					20		2		

● Delivery from stock
○ Available on short notice

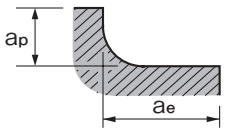
Recommended Milling Conditions

Below is a sample of work materials. For other materials, please refer to the "Technical Information" section of our website.

Work Material				~40HRC High feed roughing of free-cutting materials				Vibration control conditions: 38~53HRC Semi-roughing in high toughness mold materials				~55HRC Machining Conditions For Finishing				
				Hardened Steel • Prehardened Steel												
				SKT4 • SKD61 • NAK80 • HPM1 • DH**				DH** • DAC** • ZHD**				SKT4 • SKD61 • NAK80 • HPM1 • DH**				
Dc	r	ℓ2	Recommended Cutting Angle	Speed (min^{-1})	Feed (mm/min)	Depth of Cut		Speed (min^{-1})	Feed (mm/min)	Depth of Cut		Speed (min^{-1})	Feed (mm/min)	Depth of Cut		Clearance (mm)
						ap	ae			ap	ae			ap	ae	
1	R0.3	10	0.3°	16,000	900	0.03	0.14	16,000	900	0.03	0.14	16,000	900	0.04	0.14	0.05
		15		8,000	450	0.03	0.14	8,000	450	0.02	0.14	8,000	450	0.04	0.14	0.05
		20		6,000	350	0.02	0.14	6,000	350	0.02	0.14	6,000	350	0.04	0.14	0.03
		25		6,000	300	0.01	0.13	6,000	300	0.01	0.13	6,000	300	0.04	0.14	0.03
		30		6,000	250	0.01	0.12	6,000	250	0.01	0.12	6,000	250	0.04	0.14	0.03
1.5	R0.3	10	0.3°	16,000	1,400	0.05	0.3	16,000	1,200	0.05	0.3	16,000	1,400	0.04	0.35	0.07
		15		8,000	800	0.05	0.3	8,000	600	0.05	0.3	8,000	800	0.04	0.35	0.05
		20		5,500	550	0.04	0.3	5,500	500	0.04	0.3	5,500	550	0.04	0.35	0.05
		25		5,000	500	0.04	0.3	5,000	450	0.04	0.3	5,000	500	0.04	0.35	0.03
		30		4,500	450	0.04	0.3	4,500	400	0.04	0.3	4,500	450	0.04	0.35	0.03
2	R0.5	10	0.3°	12,000	1,450	0.15	0.4	12,000	1,100	0.15	0.4	12,000	1,100	0.06	0.4	0.07
		15		7,800	900	0.12	0.4	7,800	700	0.1	0.4	7,800	700	0.06	0.4	0.07
		20		6,200	750	0.1	0.3	6,200	600	0.07	0.3	6,200	600	0.06	0.4	0.05
		25		4,700	550	0.07	0.3	4,700	500	0.06	0.3	4,700	500	0.06	0.4	0.05
		30		3,500	400	0.07	0.3	3,500	400	0.05	0.3	3,500	400	0.06	0.4	0.05
		35		3,500	400	0.07	0.2	3,500	400	0.04	0.2	3,500	400	0.06	0.4	0.03
		40		3,500	300	0.07	0.2	3,500	300	0.04	0.2	3,500	300	0.06	0.4	0.03
		45		3,500	200	0.07	0.2	3,500	200	0.03	0.2	3,500	200	0.06	0.4	0.03
		50		3,500	150	0.06	0.1	3,500	150	0.03	0.1	3,500	200	0.06	0.4	0.03
		60		3,500	150	0.05	0.1	3,500	150	0.03	0.1	3,500	200	0.06	0.4	0.03
3	R0.8	10	0.3°	11,000	1,650	0.13	0.6	8,000	1,200	0.13	0.6	11,000	2,100	0.1	0.5	0.1
		15		10,000	1,500	0.13	0.6	8,000	1,200	0.13	0.6	10,000	1,900	0.1	0.5	0.07
		20		7,500	1,100	0.12	0.5	7,200	1,000	0.12	0.5	7,500	1,400	0.1	0.5	0.07
		25		4,800	700	0.12	0.4	4,600	650	0.12	0.4	4,800	900	0.1	0.5	0.05
		30		3,800	550	0.1	0.4	3,400	500	0.1	0.4	3,800	750	0.1	0.5	0.03
		40		2,600	450	0.08	0.3	2,600	400	0.08	0.3	2,600	550	0.1	0.5	0.03
		50		2,200	350	0.06	0.3	2,200	300	0.06	0.3	2,200	450	0.1	0.5	0.03
		60		2,200	350	0.04	0.3	2,200	300	0.04	0.3	2,200	450	0.1	0.5	0.03
4	R1	10	0.5°	9,500	2,100	0.2	0.9	6,000	1,250	0.2	0.9	9,500	2,250	0.12	0.8	0.1
		15		9,000	2,000	0.2	0.8	6,000	1,250	0.2	0.8	9,000	2,150	0.12	0.8	0.1
		20		8,200	1,700	0.2	0.7	6,000	1,250	0.14	0.7	8,200	2,000	0.12	0.7	0.1
		25		5,500	1,400	0.15	0.7	5,500	1,150	0.11	0.7	5,500	1,350	0.12	0.7	0.07
		30		4,500	1,150	0.15	0.7	4,500	900	0.09	0.7	4,500	1,100	0.12	0.7	0.07
		35		3,600	1,100	0.12	0.6	3,600	750	0.09	0.6	3,600	900	0.12	0.7	0.05
		40		3,000	900	0.12	0.6	3,000	650	0.09	0.6	3,000	800	0.12	0.7	0.05
		45		2,700	850	0.1	0.5	2,700	600	0.08	0.5	2,700	750	0.12	0.7	0.03
		50		2,500	800	0.1	0.5	2,500	550	0.08	0.5	2,500	600	0.12	0.7	0.03
		60		2,100	700	0.08	0.5	2,100	450	0.06	0.5	2,100	500	0.12	0.7	0.03
5	R1	10	0.5°	7,700	2,500	0.2	1.2	4,800	3,600	0.2	1.2	7,700	1,800	0.12	1.2	0.1
		15		7,700	2,400	0.2	1.2	4,800	3,400	0.16	1.2	6,100	1,450	0.12	1.2	0.1
		20		7,700	2,400	0.2	1.2	4,800	3,400	0.16	1.2	6,100	1,450	0.12	1.2	0.1
		25		5,100	2,200	0.17	1	4,800	3,000	0.13	1	5,100	1,200	0.12	1.2	0.07
		30		5,100	2,200	0.17	1	4,800	3,000	0.13	1	5,100	1,200	0.12	1.2	0.07
		35		4,400	1,700	0.15	1	4,400	2,400	0.09	1	4,400	1,000	0.12	1.2	0.05
		40		3,100	1,100	0.15	1	3,100	1,500	0.08	1	3,100	750	0.12	1.2	0.05
6	R1.5	24	0.5°	6,500	2,100	0.35	1.3	4,000	1,700	0.24	1.3	6,500	1,900	0.15	1.2	0.1
		30		5,100	2,000	0.24	1.2	4,000	1,700	0.23	1.2	5,100	1,500	0.15	1.2	0.1
		36		4,200	1,800	0.2	1	4,000	1,700	0.19	1	4,200	1,250	0.15	1.2	0.07
		42		3,700	1,500	0.15	1	3,700	1,400	0.14	1	3,700	1,100	0.15	1.2	0.07
		48		2,600	1,000	0.13	0.9	2,600	900	0.14	0.9	2,600	800	0.15	1.2	0.05
		54		2,100	800	0.1	0.9	2,100	800	0.1	0.9	2,100	650	0.15	1.2	0.05
		66		1,900	700	0.08	0.9	1,900	700	0.08	0.9	1,900	550	0.15	1.2	0.03
		80		1,700	600	0.05	0.9	1,700	600	0.05	0.9	1,700	450	0.15	1.2	0.03

PHX-DFR/PHX-LN-DFR/PHX-PC-DFR/PHX-CRT

Work Material				~40HRC High feed roughing of free-cutting materials				Vibration control conditions: 38~53HRC Semi-roughing in high toughness mold materials				Vibration control conditions: ~55HRC Machining Conditions For Finishing				
				Hardened Steel • Prehardened Steel												
				SKT4 • SKD61 • NAK80 • HPM1 • DH**				DH** • DAC** • ZHD**				SKT4 • SKD61 • NAK80 • HPM1 • DH**				
Dc	r	ℓ2	Recommended Cutting Angle	Speed (min^{-1})	Feed (mm/min)	Depth of Cut ap	Depth of Cut ae	Speed (min^{-1})	Feed (mm/min)	Depth of Cut ap	Depth of Cut ae	Speed (min^{-1})	Feed (mm/min)	Depth of Cut ap	Depth of Cut ae	Clearance (mm)
8	R2	30	0.5°	4,800	2,000	0.5	1.7	3,000	1,250	0.3	1.6	4,800	1,800	0.18	1.6	0.1
		40		3,800	1,900	0.4	1.6	3,000	1,250	0.3	1.6	3,800	1,400	0.18	1.6	0.1
		48		3,200	1,700	0.27	1.4	3,000	1,250	0.26	1.4	3,200	1,150	0.18	1.6	0.07
		56		2,700	1,300	0.2	1.4	2,700	1,100	0.2	1.4	2,700	1,000	0.18	1.6	0.07
		64		1,900	880	0.2	1.3	1,900	800	0.2	1.3	1,900	700	0.18	1.6	0.05
		80		1,500	700	0.15	1.3	1,500	700	0.15	1.3	1,500	550	0.18	1.6	0.03
		100		1,200	650	0.15	1.3	1,200	650	0.15	1.3	1,200	500	0.18	1.6	0.03
		120		1,000	550	0.1	1.3	1,000	550	0.1	1.3	1,000	450	0.18	1.6	0.03
10	R2	35	0.5°	3,800	2,100	0.5	2.5	2,400	1,000	0.3	1.6	3,800	1,500	0.2	2.4	0.1
		50		3,100	1,950	0.4	2.4	2,400	1,000	0.3	1.6	3,100	1,200	0.2	2.4	0.1
		60		2,500	1,750	0.27	2	2,400	1,000	0.27	1.6	2,500	1,000	0.2	2.4	0.1
		70		2,200	1,350	0.2	2	2,200	900	0.2	1.6	2,200	900	0.2	2.4	0.07
		80		1,500	900	0.19	2	1,500	680	0.19	1.6	1,500	600	0.2	2.4	0.07
		100		1,200	720	0.16	2	1,200	550	0.16	1.6	1,200	450	0.2	2.4	0.05
		120		1,050	650	0.13	2	1,000	500	0.13	1.6	1,050	400	0.2	2.4	0.05
		140		850	550	0.1	1.5	800	450	0.1	1.4	850	350	0.2	2.4	0.03
		160		700	500	0.07	1.5	700	400	0.07	1.4	700	300	0.2	2.4	0.03
12	R2	45	0.5°	3,200	2,200	0.6	3.4	2,000	840	0.3	1.6	3,200	1,500	0.24	3.2	0.15
		60		2,500	2,100	0.5	3.2	2,000	840	0.3	1.6	2,500	1,200	0.24	3.2	0.15
		70		2,100	1,900	0.4	2.8	2,000	840	0.28	1.6	2,100	1,000	0.24	3.2	0.1
		85		1,800	1,500	0.3	2.7	1,500	630	0.22	1.6	1,800	870	0.24	3.2	0.1
		100		1,300	1,000	0.2	2.6	1,200	500	0.2	1.6	1,300	630	0.24	3.2	0.1
		120		1,000	700	0.15	2.5	1,000	500	0.15	1.6	1,000	480	0.24	3.2	0.05
		140		900	600	0.15	2	900	400	0.1	1.6	900	440	0.24	3.2	0.05
		160		700	500	0.1	2	700	400	0.1	1.6	700	380	0.24	3.2	0.05
16	R3	55	0.5°	2,400	2,000	0.5	4.2	1,500	630	0.3	1.6	2,400	1,350	0.3	4	0.2
		80		1,900	1,900	0.47	4	1,500	630	0.3	1.6	1,900	1,100	0.3	4	0.15
		90		1,600	1,700	0.4	3.4	1,500	630	0.3	1.6	1,600	900	0.3	4	0.1
		105		1,400	1,300	0.29	3.3	1,400	580	0.28	1.6	1,400	800	0.3	4	0.07
		120		1,000	850	0.2	3.2	1,000	450	0.2	1.6	1,000	600	0.3	4	0.05
20	R3	70	0.5°	1,900	2,000	0.5	5.5	1,200	500	0.3	1.6	1,900	1,550	0.42	5.5	0.2
		90		1,500	1,900	0.47	5.3	1,200	500	0.3	1.6	1,500	1,200	0.42	5.5	0.15
		110		1,300	1,700	0.42	4.2	1,200	500	0.3	1.6	1,300	1,050	0.42	5.5	0.1
		130		1,100	1,300	0.31	3.8	1,100	450	0.3	1.6	1,100	900	0.42	5.5	0.07
		150		760	870	0.25	3.4	760	350	0.23	1.6	760	600	0.42	5.5	0.05



1. The above mentioned conditions according to projection lengths are intended as general guidelines for reference only. Adjustments should be made based on actual milling conditions.
2. Highly rigid machines and tool holders should be used.
3. Tool vibrations should be kept at a minimum level for maximum accuracy.
4. Under general machining condition, air-blow cutting method is recommended.
5. In the case of linear machining, do not use the ae value, instead refer to the ap value.
6. More stable high-feed machining in the corners can be attained by setting an R insertion or deceleration on the CAM or machine side.
7. When cutting load fluctuates (in the corners, etc.) or when high precision is required, be sure to control the rotational speed.
8. When cutting at greater than the recommended cutting angle, reduce the feed.
9. When the depth of cut is less than the specified amount as listed above, the feed rate can be increased up to 150%.
10. When the depth of cut is greater than the specified amount as listed above, the feed rate can be reduced by no more than 60% to ensure stable milling.

Recommended Milling Conditions

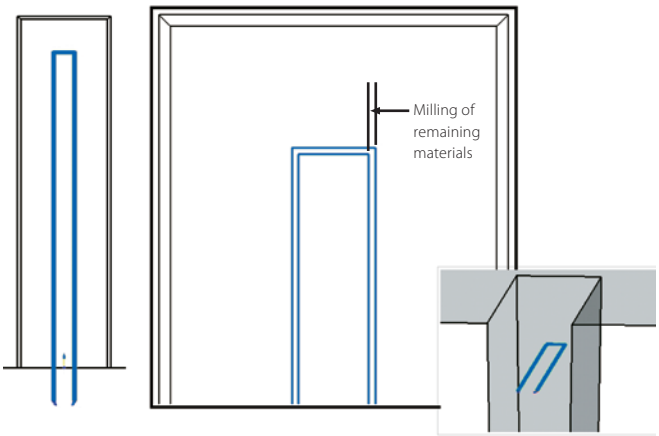
Below is a sample of work materials. For other materials, please refer to the "Technical Information" section of our website.

Work Material			~40HRC High feed roughing of free-cutting materials				Vibration control conditions: ~53HRC Semi-roughing in high toughness mold materials				~53HRC Machining Conditions For Slotting				~55HRC Machining Conditions For Finishing				
			Hardened Steel • Prehardened Steel																
			SKT4 • SKD61 • NAK80 • HPM1 • DH**				DH** • DAC** • ZHD**				SKT4 • SKD61 • NAK80 • HPM1 • DH**				SKT4 • SKD61 • NAK80 • HPM1 • DH**				
R	ℓ2	Recommended Cutting Angle	Speed (min^{-1})	Feed (mm/min)	Depth of Cut ap	Depth of Cut Pf	Speed (min^{-1})	Feed (mm/min)	Depth of Cut ap	Depth of Cut Pf	Speed (min^{-1})	Feed (mm/min)	Depth of Cut ap	Depth of Cut Pf	Speed (min^{-1})	Feed (mm/min)	Depth of Cut ap	Depth of Cut Pf	Clearance (mm)
R0.5	6	0.3°	18,000	1,000	0.05	0.16	18,000	900	0.05	0.16	18,000	280	0.007	0.03	18,000	1,200	0.03	0.03	0.05
	10		16,000	800	0.04	0.16	16,000	800	0.04	0.16	16,000	120	0.003	0.3	16,000	1,000	0.03	0.03	0.03
	15		8,000	420	0.03	0.16	8,000	420	0.03	0.16	–	–	–	–	8,000	500	0.03	0.03	0.03
	20		6,000	300	0.02	0.12	6,000	300	0.02	0.12	–	–	–	–	6,000	380	0.03	0.03	0.03
	25		6,000	130	0.02	0.08	6,000	130	0.02	0.08	–	–	–	–	6,000	350	0.03	0.03	0.03
	30		6,000	90	0.01	0.05	6,000	90	0.01	0.05	–	–	–	–	6,000	250	0.03	0.03	0.03
R0.75	6	0.3°	18,000	1,500	0.1	0.3	16,000	1,300	0.1	0.3	16,000	650	0.07	0.15	18,000	1,100	0.04	0.04	0.05
	10		15,000	1,100	0.06	0.25	15,000	950	0.06	0.25	15,000	320	0.01	0.1	15,000	900	0.04	0.04	0.03
	16		7,500	230	0.02	0.2	7,500	200	0.02	0.2	7,500	300	0.007	0.05	7,500	450	0.04	0.04	0.03
R1	6	0.3°	18,000	1,600	0.2	0.6	15,000	1,400	0.2	0.4	12,000	600	0.15	0.15	15,000	1,800	0.06	0.05	0.1
	10		12,000	1,250	0.14	0.4	12,000	1,100	0.14	0.4	12,000	600	0.1	0.05	12,000	1,500	0.06	0.05	0.07
	15		7,800	820	0.14	0.4	7,800	780	0.14	0.4	7,800	450	0.07	0.05	7,800	980	0.06	0.05	0.07
	20		6,200	650	0.13	0.4	6,200	600	0.13	0.3	6,200	340	0.05	0.05	6,200	600	0.06	0.05	0.05
	25		4,700	500	0.12	0.3	4,700	500	0.12	0.3	–	–	–	–	4,700	450	0.06	0.05	0.05
	30		3,500	400	0.1	0.3	3,500	400	0.1	0.3	–	–	–	–	3,500	450	0.06	0.05	0.05
	35		3,500	400	0.07	0.3	3,500	400	0.07	0.3	–	–	–	–	3,500	450	0.06	0.05	0.03
	40		3,500	300	0.07	0.25	3,500	300	0.07	0.25	–	–	–	–	3,500	450	0.06	0.05	0.03
	45		3,500	200	0.07	0.2	3,500	200	0.07	0.2	–	–	–	–	3,500	450	0.06	0.05	0.03
	50		3,500	150	0.06	0.1	3,500	150	0.06	0.1	–	–	–	–	3,500	450	0.06	0.05	0.03
	60		3,500	150	0.05	0.1	3,500	150	0.05	0.1	–	–	–	–	3,500	450	0.06	0.05	0.03
R1.5	10	0.3°	12,000	1,900	0.21	0.5	8,000	1,200	0.21	0.5	8,000	700	0.13	0.1	11,000	2,050	0.09	0.08	0.1
	15		10,000	1,550	0.2	0.5	8,000	1,200	0.2	0.5	8,000	550	0.1	0.1	10,000	1,900	0.09	0.08	0.07
	20		7,500	1,150	0.19	0.5	7,200	1,100	0.19	0.5	7,200	480	0.06	0.07	7,500	1,400	0.09	0.08	0.07
	25		4,800	750	0.19	0.5	4,600	700	0.19	0.5	4,600	320	0.04	0.05	4,800	900	0.09	0.08	0.05
	30		4,000	630	0.16	0.4	3,400	500	0.16	0.4	3,400	240	0.02	0.03	3,800	720	0.09	0.08	0.03
	40		2,800	440	0.13	0.4	2,600	400	0.13	0.4	–	–	–	–	2,600	500	0.09	0.08	0.03
	50		2,200	350	0.1	0.4	2,200	300	0.1	0.4	–	–	–	–	2,200	400	0.09	0.08	0.03
	60		2,200	350	0.07	0.4	2,200	300	0.07	0.4	–	–	–	–	2,200	400	0.09	0.08	0.03
R2	10	0.5°	9,600	2,000	0.3	0.6	6,000	1,250	0.3	0.6	6,000	800	0.15	0.1	9,500	2,400	0.12	0.1	0.1
	15		9,300	1,900	0.27	0.6	6,000	1,200	0.27	0.6	6,000	800	0.12	0.1	9,000	2,250	0.12	0.1	0.1
	20		7,600	1,550	0.25	0.6	6,000	1,150	0.25	0.6	6,000	700	0.1	0.07	8,200	2,050	0.12	0.1	0.1
	25		6,100	1,250	0.23	0.6	5,500	1,100	0.23	0.6	5,500	450	0.05	0.07	5,500	1,350	0.12	0.1	0.07
	30		5,000	1,050	0.2	0.6	4,500	800	0.2	0.6	4,500	350	0.03	0.05	4,500	1,100	0.12	0.1	0.07
	35		3,600	750	0.16	0.5	3,600	650	0.16	0.5	3,600	280	0.01	0.03	3,600	900	0.12	0.1	0.05
	40		3,000	630	0.12	0.5	3,000	550	0.12	0.5	3,000	150	0.007	0.01	3,000	750	0.12	0.1	0.05
	45		2,700	550	0.1	0.4	2,700	500	0.1	0.4	–	–	–	–	2,700	680	0.12	0.1	0.03
	50		2,500	520	0.1	0.4	2,500	450	0.1	0.4	–	–	–	–	2,500	630	0.12	0.1	0.03
	60		2,100	430	0.08	0.4	2,100	400	0.08	0.4	–	–	–	–	2,100	530	0.12	0.1	0.03
R2.5	10	0.5°	7,700	1,900	0.35	0.8	4,800	1,100	0.35	0.8	4,800	900	0.2	0.1	7,700	2,400	0.15	1.2	0.1
	15		7,700	1,900	0.3	0.8	4,800	1,000	0.3	0.8	4,800	850	0.16	0.1	6,100	1,900	0.15	1.2	0.1
	20		7,700	1,800	0.3	0.8	4,800	950	0.3	0.8	4,800	700	0.12	0.07	6,100	1,900	0.15	1.2	0.1
	25		5,100	1,300	0.25	0.8	4,800	900	0.25	0.8	4,800	650	0.06	0.05	5,100	1,600	0.15	1.2	0.07
	30		5,100	1,200	0.2	0.6	4,800	850	0.2	0.6	4,800	500	0.03	0.05	5,100	1,600	0.15	1.2	0.07
	35		4,400	1,100	0.14	0.6	4,400	750	0.14	0.6	4,400	400	0.015	0.03	4,400	1,350	0.15	1.2	0.05
	40		3,100	750	0.1	0.6	3,100	650	0.1	0.6	3,100	260	0.007	0.03	3,100	950	0.15	1.2	0.05
R3	24	0.5°	6,400	1,900	0.43	1.2	4,000	1,200	0.3	1	4,000	900	0.3	0.1	6,500	1,450	0.18	0.16	0.1
	30		5,100	1,500	0.34	1.2	4,000	1,150	0.3	1	4,000	900	0.25	0.1	5,100	1,950	0.18	0.16	0.1
	36		4,200	1,250	0.38	1.2	4,000	1,100	0.3	1	4,000	750	0.2	0.07	4,200	1,580	0.18	0.16	0.07
	42		3,700	1,050	0.2	0.9	3,700	1,000	0.2	1	3,700	500	0.15	0.05	3,700	1,400	0.18	0.16	0.07
	48		3,600	750	0.15	0.9	2,600	700	0.15	0.8	2,600	400	0.1	0.03	2,600	980	0.18	0.16	0.05
	54		2,100	630	0.1	0.8	2,100	600	0.1	0.8	2,100	240	0.05	0.03	2,100	800	0.18	0.16	0.05
	66		1,900	550	0.08	0.7	1,900	500	0.08	0.7	–	–	–	–	1,900	700	0.18	0.16	0.03
	80		1,700	450	0.08	0.6	1,700	400	0.08	0.6	–	–	–	–	1,700	650	0.18	0.16	0.03

PHX-DBT / PHX-PC-DBT

Work Material			~40HRC High feed roughing of free-cutting materials				Vibration control conditions: ~53HRC Semi-roughing in high toughness mold materials				~53HRC Machining Conditions For Slotting				~55HRC Machining Conditions For Finishing				
			Hardened Steel • Prehardened Steel																
			SKT4 • SKD61 • NAK80 • HPM1 • DH**				DH** • DAC** • ZHD**				SKT4 • SKD61 • NAK80 • HPM1 • DH**				SKT4 • SKD61 • NAK80 • HPM1 • DH**				
R	ℓ2	Recommended Cutting Angle	Speed (min^{-1})	Feed (mm/min)	Depth of Cut ap	Depth of Cut Pf	Speed (min^{-1})	Feed (mm/min)	Depth of Cut ap	Depth of Cut Pf	Speed (min^{-1})	Feed (mm/min)	Depth of Cut ap	Depth of Cut Pf	Speed (min^{-1})	Feed (mm/min)	Depth of Cut ap	Depth of Cut Pf	Clearance (mm)
R4	30	0.5°	4,800	2,300	0.45	1.5	3,000	1,260	0.3	1.5	3,000	1,050	0.3	0.15	4,800	2,400	0.24	0.21	0.1
	40		3,800	1,800	0.38	1.3	3,000	1,200	0.3	1.3	3,000	1,050	0.3	0.1	3,800	1,900	0.24	0.21	0.1
	48		3,200	1,500	0.28	1.2	3,000	1,100	0.25	1.2	3,000	900	0.25	0.1	3,200	1,600	0.24	0.21	0.07
	56		2,700	1,300	0.2	1.1	2,700	1,000	0.2	1.1	2,700	800	0.2	0.07	2,700	1,350	0.24	0.21	0.07
	64		1,900	900	0.2	1	1,900	700	0.17	1	1,900	500	0.17	0.07	1,900	950	0.24	0.21	0.05
	80		1,500	700	0.15	0.8	1,500	550	0.14	0.8	–	–	–	–	1,500	750	0.24	0.21	0.03
	100		1,200	600	0.15	0.8	1,200	400	0.1	0.8	–	–	–	–	1,200	600	0.24	0.21	0.03
	120		1,000	500	0.1	0.7	1,000	350	0.07	0.7	–	–	–	–	1,000	500	0.24	0.21	0.03
R5	35	0.5°	3,800	2,300	0.65	1.8	2,400	1,000	0.4	1.6	2,400	850	0.4	0.15	3,800	2,400	0.3	0.27	0.1
	50		3,100	1,900	0.55	1.8	2,400	1,000	0.3	1.6	2,400	850	0.3	0.15	3,100	1,950	0.3	0.27	0.1
	60		2,500	1,500	0.46	1.6	2,400	1,000	0.3	1.5	2,400	850	0.3	0.1	2,500	1,550	0.3	0.27	0.1
	70		2,200	1,300	0.34	1.6	2,200	900	0.3	1.5	2,200	800	0.3	0.1	2,200	1,350	0.3	0.27	0.07
	80		1,500	800	0.24	1.6	1,500	600	0.2	1.5	1,500	600	0.2	0.07	1,500	950	0.3	0.27	0.07
	100		1,200	600	0.15	1.5	1,200	500	0.12	1.5	1,200	500	0.12	0.07	1,200	750	0.3	0.27	0.05
	120		1,050	500	0.1	1.3	1,000	400	0.1	1.3	–	–	–	–	1,050	650	0.3	0.27	0.05
	140		850	400	0.07	1.3	800	350	0.07	1.3	–	–	–	–	850	500	0.3	0.27	0.03
	160		700	320	0.07	1	700	300	0.07	1	–	–	–	–	700	450	0.3	0.27	0.03
R6	45	0.5°	3,200	1,700	0.8	2	2,000	800	0.8	1.8	2,000	800	0.6	0.15	3,200	2,400	0.36	0.32	0.15
	60		2,500	1,300	0.65	2	2,000	800	0.65	1.8	2,000	800	0.5	0.15	2,500	1,900	0.36	0.32	0.15
	70		2,100	1,100	0.57	2	2,000	800	0.57	1.8	2,000	800	0.5	0.1	2,100	1,600	0.36	0.32	0.1
	85		1,800	950	0.42	1.8	1,500	600	0.42	1.7	1,500	600	0.4	0.1	1,800	1,350	0.36	0.32	0.1
	100		1,300	690	0.3	1.8	1,200	500	0.3	1.7	1,200	500	0.3	0.1	1,300	980	0.36	0.32	0.1
	120		1,000	530	0.25	1.5	1,000	420	0.25	1.5	–	–	–	–	1,000	750	0.36	0.32	0.05
	140		900	470	0.2	1.5	900	380	0.2	1.5	–	–	–	–	900	680	0.36	0.32	0.05
	160		700	370	0.15	1.3	700	300	0.15	1.3	–	–	–	–	700	530	0.36	0.32	0.05
R8	55	0.5°	2,400	1,600	1	2.2	1,500	600	1	1.8	1,500	600	0.8	0.15	2,400	2,400	0.48	0.4	0.2
	80		1,900	1,250	0.9	2.2	1,500	600	0.9	1.8	1,500	600	0.8	0.15	1,900	1,900	0.48	0.4	0.15
	90		1,600	1,050	0.75	2.2	1,500	600	0.75	1.8	1,500	600	0.7	0.1	1,600	1,600	0.48	0.4	0.1
	105		1,400	900	0.55	2	1,400	570	0.55	1.7	1,400	570	0.5	0.07	1,400	1,400	0.48	0.4	0.07
	120		1,000	650	0.4	2	1,000	420	0.4	1.7	1,000	420	0.4	0.05	1,000	1,000	0.48	0.4	0.05
R10	70	0.5°	1,900	1,500	1.2	3.6	1,200	500	1.2	1.8	1,200	500	0.8	0.15	1,900	2,400	0.6	0.5	0.2
	90		1,500	1,200	1.1	3.6	1,200	500	1.1	1.8	1,200	500	0.8	0.15	1,500	1,900	0.6	0.5	0.15
	110		1,300	1,000	0.9	3.5	1,200	500	0.9	1.8	1,200	500	0.8	0.1	1,300	1,600	0.6	0.5	0.1
	130		1,100	850	0.7	3.4	1,100	450	0.7	1.8	1,100	450	0.7	0.1	1,100	1,400	0.6	0.5	0.07
	150		760	600	0.5	3.3	760	320	0.5	1.8	760	320	0.5	0.07	760	950	0.6	0.5	0.05

1. The above mentioned conditions according to projection lengths are intended as general guidelines for reference only. Adjustments should be made based on actual milling conditions.
2. Highly rigid machines and tool holders should be used.
3. Tool vibrations should be kept at a minimum level for maximum accuracy.
4. Under general machining condition, air-blow cutting method is recommended.
5. In the case of linear machining, do not use the ae value, instead refer to the ap value.
6. More stable high-feed machining in the corners can be attained by setting an R insertion or deceleration on the CAM or machine side.
7. When cutting load fluctuates (in the corners, etc.) or when high precision is required, be sure to control the rotational speed.
8. When cutting at greater than the recommended cutting angle, reduce the feed.
9. When the depth of cut is less than the specified amount as listed above, the feed rate can be increased up to 150%.
10. When the depth of cut is greater than the specified amount as listed above, the feed rate can be reduced by no more than 60% to ensure stable milling.



In comparison to radius end mills, ball end mills machine less materials per pass. In order to improve the precision of the ribs, please separate the roughing and finishing procedures.

To maximize performance of the Phoenix Series

How to calculate milling conditions

When you calculate the milling conditions, it is much more convenient if you use the following equations!

n = (min^{-1})

$$n = Vc \div 3.14 \div Dc \times 1{,}000$$

* Dc=diameter

Vc = (m/min)

$$Vc = n \times 3.14 \times Dc \div 1{,}000$$

* Dc=diameter

Vf = (mm/min)

$$Vf = n \times z \times fz$$

*Z=number of flute

fz = (mm/t)

$$fz = Vf \div z \div n$$

*Z=number of flute

Calculating the PHX-DFR φ10×R2 with a calculator

Tool	PHX-DFR φ10×R2
Milling Speed	39.25m/min (1,250min^{-1})
Feed	1,500mm/min (0.4mm/t)

39.25m/min÷3.14÷φ10×1,000
n = 1,250min^{-1}

1,250min^{-1}×3.14×φ10÷1,000
Vc = 39.25m/min

1,250min^{-1}×3×0.4mm/t
Vf = 1,500mm/min

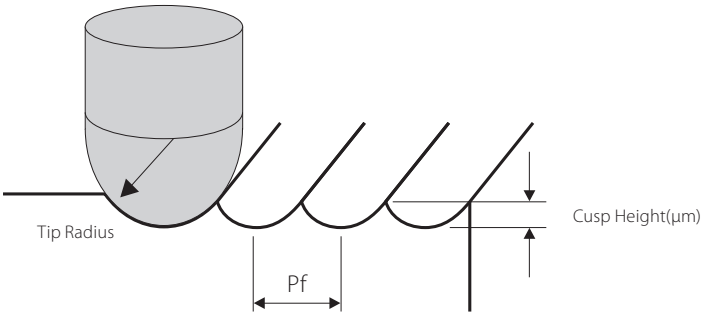
1,500mm/min÷3÷1,250min^{-1}
fz = 0.4mm/t

Also take the cusp height and pick feed into account. The cusp height and pick feed are indicated as below.

The value of cusp height (μm)

h = (μm)

$$h = R - \sqrt{R^2 - \left(\frac{Pf}{2}\right)^2}$$



Calculating the PHX-DBT R5×100 with a calculator

$$h = R - \sqrt{R^2 - \left(\frac{Pf}{2}\right)^2}$$

0.3÷2
= 0.15

5×5
= 25

0.15×0.15
= 0.0225

25 − 0.0225
= 24.9775

$\sqrt{\ }$ 24.9775

$\sqrt{\ }$ = 4.99775

5 − 4.99775

h = 0.00225μm

Approximate depth of cut for semi-finishing and finishing (mm)

• Approximate depth of cut for semi-finishing: R×ap0.13 • Approximate depth of cut for finishing: R×ap0.06

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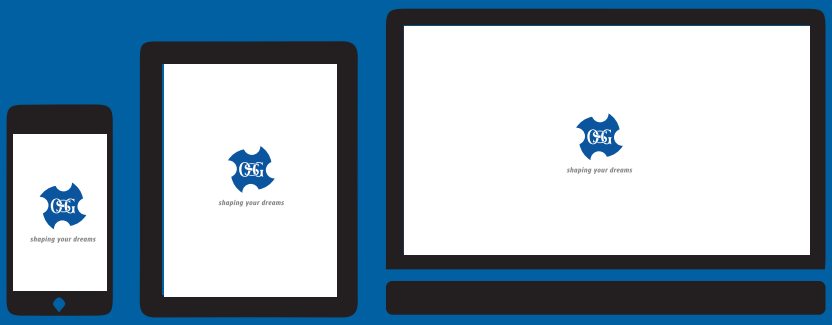

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OSG EUROPE LOGISTICS
Avenue Lavoisier 1
B-1300 Z.I. Wavre - Nord
Belgium
Tel.: +32 10 23 05 07
Fax: +32 10 23 05 11
info@osgeurope.com

OSG BELUX
Avenue Lavoisier 1
B-1300 Z.I. Wavre - Nord
Belgium
Tel.: +32 10 23 05 11
Fax: +32 10 23 05 31
info@osg-belgium.com

OSG FRANCE
Parc Icade, Paris Nord 2
Immeuble "Le Rimbaud"
22 Avenue des Nations
CS66191 - 93420 Villepinte
France
Tel.: +33 1 49 90 10 10
Fax: +33 1 49 90 10 15
sales@osg-france.com

OSG NETHERLANDS
Bedrijfsweg 5 - 3481 MG Harmelen
Postbus 50 - 3480 DB Harmelen
The Netherlands
Tel.: +31 348 44 2764
Fax: +31 348 44 2144
info@osg-nl.com

OSG UK
Shelton house, 5 Bentalls
Pipps Hill Ind Est, Basildon Essex SS14 3BY
United Kingdom
Tel.: +44 845 305 1066
Fax: +44 845 305 1067
sales@osg-uk.com

SLOVAKIA
Branch office of OSG Europe Logistics s.a.
Tel (SK) +421 2 4329 1295
Tel (BE) +32 10 23 05 07
Fax (BE) +32 10 23 05 51
sales-osgsvk@osgeurope.com

OSG POLAND Sp. z.o.o.
ul. Spółdzielcza 57
05-074 Halinów
Poland
Tel: +22 760 82 71
Fax: +22 760 82 71
osg@osg-poland.com

OSG GERMANY
Karl-Ehmann-Str. 25
D - 73037 Göppingen
Germany
Tel.: +49 7161 6064 - 0
Fax: +49 7161 6064 - 444
info@osg-germany.de

OSG SCANDINAVIA
(For Scandinavian countries)
Langebjergvaenget 16
4000 Roskilde
Denmark
Tel.: +45 46 75 65 55
Fax: +45 46 75 67 00
osg@osg-scandinavia.com

SWEDEN
Branch office of OSG SCANDINAVIA
Abrahams Gränd 8
295 35 Bromölla
Sweden
Tel: +46 40 41 22 55
Fax: +46 40 41 32 55
osg@osg-scandinavia.com

OSG COMAHER
Bekolarra 4
E - 01010 Vitoria-Gasteiz
Spain
Tel.: +34 945 242 400
Fax: +34 945 228 883
osg-comaher@osg-comaher.com

OSG ITALIA
Via Cirenaica n. 52 int. 61/63
I - 10142 Torino
Italy
Tel.: +39 0117705211
Fax: +39 0117071402
info@osg-italia.it

OSG TURKEY
Rami Kişla Cad.No:56 Eyüp
Istanbul 34056
Turkey
Tel.+90 212 565 24 00
Fax: +90 212 565 44 00
info@osg-turkey.com

ROMSAN INTERNATIONAL CO. SRL
Reprezentant Exclusiv OSG
23-25, Nerva Traian Street
031044 Bucuresti
România
Tel.: +40 021 322 07 47
Fax: +40 021 321 56 00
romsan.int@romsan.ro

OSG EUROPE LOGISTICS S.A.

www.osgeurope.com