OSG PHOENIX®

PXRE End Mills
PH Machining Guide

Roughing & Finishing (LDR 4xD)

For LDR Greater See LDR Notes

RPM/Spindle Speed

Material		Carbon/Alloy Steel (30-40 HRC)		Tool Steel (40-50 HRC)		Tool Steel (50-60 HRC)	
Diameter		Rough	Finish	Rough	Finish	Rough	Finish
Inch	mm						
0.375	-	4590 - 6625	6120 - 9175	2550 - 4075	3570 - 5600	2295 - 3570	3315 - 5100
-	10	4375 - 6315	5835 - 8750	2430 - 3885	3400 - 5340	2190 - 3400	3160 - 4860
-	12	3640 - 5255	4850 - 7280	2020 - 3235	2830 - 4450	1820 - 2830	2630 - 4045
0.500	-	3440 - 4965	4585 - 6875	1910 - 3055	2675 - 4200	1720 - 2675	2485 - 3820
0.625	-	2750 - 3975	3670 - 5500	1530 - 2450	2140 - 3360	1375 - 2140	1985 - 3055
-	16	2730 - 3940	3640 - 5460	1520 - 2425	2125 - 3335	1365 - 2125	1970 - 3035
0.750	-	2290 - 3310	3055 - 4585	1275 - 2040	1785 - 2800	1150 - 1785	1655 - 2550
-	20	2180 - 3150	2910 - 4365	1215 - 1940	1700 - 2670	1090 - 1700	1575 - 2425
-	25	1750 - 2520	2340 - 3500	970 - 1550	1360 - 2135	875 - 1365	1260 - 1940
1.000	-	1720 - 2480	2300 - 3440	955 - 1530	1340 - 2100	860 - 1340	1240 - 1910

Chip Load/Inch Per Tooth

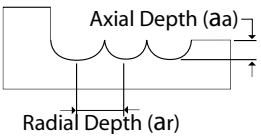
Material		Carbon/Alloy Steel (30-40 HRC)		Tool Steel (40-50 HRC)		Tool Steel (50-60 HRC)	
Diameter		Rough	Finish	Rough	Finish	Rough	Finish
Inch	mm						
0.375	-	0.0112 - 0.0119	0.0101 - 0.0107	0.0090 - 0.0108	0.0080 - 0.0097	0.0070 - 0.0084	0.0063 - 0.0075
-	10	0.0112 - 0.0119	0.0101 - 0.0107	0.0090 - 0.0108	0.0080 - 0.0097	0.0070 - 0.0084	0.0063 - 0.0075
-	12	0.0150 - 0.0159	0.0135 - 0.0143	0.0120 - 0.0144	0.0108 - 0.0129	0.0094 - 0.0112	0.0084 - 0.0100
0.500	-	0.0150 - 0.0159	0.0135 - 0.0143	0.0120 - 0.0144	0.0108 - 0.0129	0.0094 - 0.0112	0.0084 - 0.0100
0.625	-	0.0161 - 0.0168	0.0144 - 0.0151	0.0128 - 0.0153	0.0115 - 0.0137	0.0104 - 0.0124	0.0093 - 0.0111
-	16	0.0161 - 0.0168	0.0144 - 0.0151	0.0128 - 0.0153	0.0115 - 0.0137	0.0104 - 0.0124	0.0093 - 0.0111
0.750	-	0.0169 - 0.0178	0.0152 - 0.0160	0.0135 - 0.0162	0.0121 - 0.0145	0.0103 - 0.0123	0.0092 - 0.0110
-	20	0.0169 - 0.0178	0.0152 - 0.0160	0.0135 - 0.0162	0.0121 - 0.0145	0.0103 - 0.0123	0.0092 - 0.0110
-	25	0.0225 - 0.0237	0.0203 - 0.0213	0.0180 - 0.0216	0.0161 - 0.0193	0.0137 - 0.0164	0.0127 - 0.0147
1.000	-	0.0225 - 0.0237	0.0203 - 0.0213	0.0180 - 0.0216	0.0161 - 0.0193	0.0137 - 0.0164	0.0127 - 0.0147

Axial and Radial Depths

Material Hardness	Carbon/Alloy Steel (30-40 HRC)	Tool Steel (40-50 HRC)	Tool Steel (50-60 HRC)	Tool Steel (Over 60 HRC)
Axial Depth (aa)	10% of Corner Rad. Max.	10% of Corner Rad. Max.	10% of Corner Rad. Max.	10% of Corner Rad. Max.
Radial Depth (ar)	40% of tool Dia. Max.	35% of tool Dia. Max.	30% of tool Dia. Max.	25% of tool Dia. Max.

Length-to-Diameter Compensions

Overhang Length	Cutting Speed	Chip Load	Aa	Ar
LDR Under 4xD	100%	100%	100%	100%
LDR 4xD to 6xD	60% - 80%	60% - 80%	60% - 80%	100%
LDR 6xD to 10xD	40% - 60%	40% - 60%	40% - 60%	100%

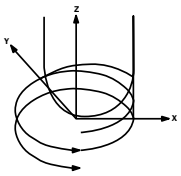


Carbide shank recommended for LDR 6xD and above.

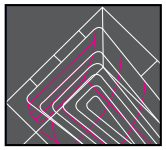
High Speed Machining Guide

Machining Tips

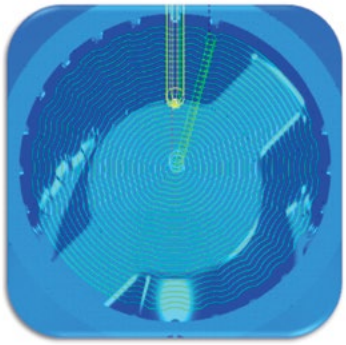
- Use Z-Level climb cutting for roughing operations.
- Use Helical for material engagement whenever possible. Use 3° ramp angle and 0.8xDiameter of cutter for the tool path arc.
- Add radiuses larger than cutter to corner of tool path for smooth operation.
- LDR should always be as short as possible.
- LDR of 4xD or less use chart on reverse side with high speed steel body.
- LDR of 6xD to 10xD use chart on reverse side with carbide body.
- **Machining is very difficult over 10xD.**
- Leave extra stock for semi-finishing to prevent gouging of surface when using long reach tools.
- Use air or oil mist for all applications except those involving gummy or sticky materials such as stainless, which machines well with water based coolant.



Helical Interpolation



Corner Rounding on Tool Path



Z-Level Machining with Climb Cutting is Highly Recommended

Diagnosing Problems

Insert Chipping - early during use means chip load too high, please reduce feed rate in increments of 20% until problem is resolved or shorten the length of the tool.

Insert Burning - of coating or glowing at the tip means RPM is too high. Reduce RPM by 20% increments until problem is resolved along with feed rate until excessive heat is subdued.

Chatter - excessive tool length is a primary cause. After reducing tool length if possible, lower RPM and feed rate until chatter is minimized.

Formulas

RPM = (3.82 x SFM) / Tool Diameter
SFM = 0.262 x RPM x Tool Diameter

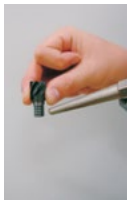
IPM = RPM x # Flutes x Chip Load
Chip Load = IPM / (RPM x # Flutes)

Stock Left for Semi-Finishing

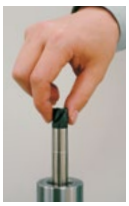
Medium parts 6" square to 24"

- No heat treat: leave 0.010" to 0.015" stock.
- Heat treat: leave 0.015" to 0.030" stock, depending on geometry.

Exchangeable Head Tightening Procedure



Step 1: Cleaning
Remove dirt and chips from the connecting thread & shank.

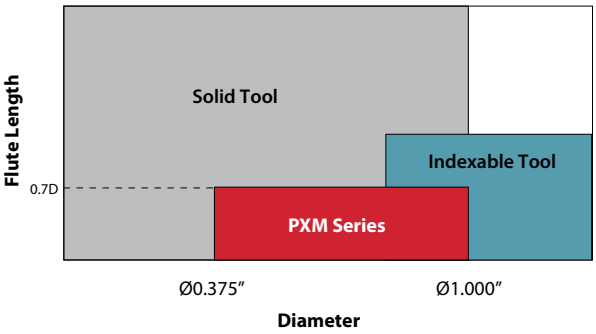


Step 2: Attach Head
Attach PXM head to shank and tighten by hand.

Step 3: Tighten Head
Tighten PXM head using supplied spanner wrench.

Step 4: Check
Confirm there is no gap between PXM head and shank.

The Complete Milling Tool Offering



Compared to solid tools	PXM offers similar productivity & precision, increased flexibility, and greater cost savings than solid tools at larger diameters.
Compared to indexable tools	PXM offers increased productivity and higher precision than indexable tools at smaller diameters.

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