



# PSE 90° Shoulder Cutter

## PH Machining Guide

### Face Milling - Roughing & Semi-Finishing (LDR 4xD)

For LDR Greater See LDR Notes

#### High Speed Machining Guide (Aggressive Parameters)

Insert Size	Material			Carbon/Alloy Steel (30-40 HRC)				Tool Steel (40-50 HRC)				Tool Steel (50-60 HRC)*			
	Tool Dia. (Inch)	Tool Dia. (mm)	No. Teeth	RPM	Feed per Tooth	Feed Rate (IPM)	Axial Cut Depth (aa)	RPM	Feed per Tooth	Feed Rate (IPM)	Axial Cut Depth (aa)	RPM	Feed per Tooth	Feed Rate (IPM)	Axial Cut Depth (aa)
ZDKT11	0.625	16	2	3820	0.005	38.20	0.050	1990	0.004	15.92	0.025	1500	0.0025	7.50	0.005
	0.750	20	3	3185	0.005	47.78	0.050	1655	0.004	19.86	0.025	1250	0.0025	9.38	0.005
	1.000	25	3	2390	0.005	35.85	0.050	1240	0.004	14.88	0.025	935	0.0025	7.01	0.005
			4	2390	0.005	47.80	0.050	1240	0.004	19.84	0.025	935	0.0025	9.35	0.005
	1.250	32	3	1910	0.005	28.65	0.050	995	0.004	11.94	0.025	750	0.0025	5.63	0.005
			5	1910	0.005	47.75	0.050	995	0.004	19.90	0.025	750	0.0025	9.38	0.005
	2.000	50	5	1195	0.005	29.88	0.050	620	0.004	12.40	0.025	470	0.0025	5.88	0.005
			7	1195	0.005	41.83	0.050	620	0.004	17.36	0.025	470	0.0025	8.23	0.005
	2.500	63	6	955	0.005	28.65	0.050	500	0.004	12.00	0.025	375	0.0025	5.63	0.005
			8	955	0.005	38.20	0.050	500	0.004	16.00	0.025	375	0.0025	7.50	0.005
3.000	80	7	795	0.005	27.83	0.050	415	0.004	11.62	0.025	310	0.0025	5.43	0.005	
		10	795	0.005	39.75	0.050	415	0.004	16.60	0.025	310	0.0025	7.75	0.005	
ZDKT15	1.000	25	2	2390	0.006	28.68	0.100	1240	0.005	12.40	0.030	935	0.0035	6.55	0.010
	1.250	32	2	1910	0.006	22.92	0.100	995	0.005	9.95	0.030	750	0.0035	5.25	0.010
			3	1910	0.006	34.38	0.100	995	0.005	14.93	0.030	750	0.0035	7.88	0.010
	1.500	40	3	1590	0.006	28.62	0.100	830	0.005	12.45	0.030	625	0.0035	6.56	0.010
			4	1590	0.006	38.16	0.100	830	0.005	16.60	0.030	625	0.0035	8.75	0.010
	2.000	50	3	1195	0.006	21.51	0.100	620	0.005	9.30	0.030	470	0.0035	4.94	0.010
			5	1195	0.006	35.85	0.100	620	0.005	15.50	0.030	470	0.0035	8.23	0.010
	2.500	63	4	955	0.006	22.92	0.100	500	0.005	10.00	0.030	375	0.0035	5.25	0.010
			6	955	0.006	34.38	0.100	500	0.005	15.00	0.030	375	0.0035	7.88	0.010
	3.000	80	5	795	0.006	23.85	0.100	415	0.005	10.38	0.030	310	0.0035	5.43	0.010
			8	795	0.006	38.16	0.100	415	0.005	16.60	0.030	310	0.0035	8.68	0.010
	4.000	100	7	600	0.006	25.20	0.100	310	0.005	10.85	0.030	235	0.0035	5.76	0.010
			10	600	0.006	36.00	0.100	310	0.005	15.50	0.030	235	0.0035	8.23	0.010
	5.000	125	8	480	0.006	23.04	0.100	250	0.005	10.00	0.030	190	0.0035	5.32	0.010
11			480	0.006	31.68	0.100	250	0.005	13.75	0.030	190	0.0035	7.32	0.010	
6.000	160	10	400	0.006	24.00	0.100	210	0.005	10.50	0.030	155	0.0035	5.42	0.010	
		12	400	0.006	28.80	0.100	210	0.005	12.60	0.030	155	0.0035	6.51	0.010	

\*Materials hardened to 50-60HRC are very difficult to machine and not recommended.

#### Machining Guide (Moderate Parameters)

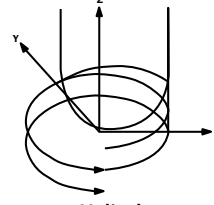
Insert Size	Material			Carbon/Alloy Steel (30-40 HRC)				Tool Steel (40-50 HRC)				Tool Steel (50-60 HRC)*			
	Tool Dia. (Inch)	Tool Dia. (mm)	No. Teeth	RPM	Feed per Tooth	Feed Rate (IPM)	Axial Cut Depth (aa)	RPM	Feed per Tooth	Feed Rate (IPM)	Axial Cut Depth (aa)	RPM	Feed per Tooth	Feed Rate (IPM)	Axial Cut Depth (aa)
ZDKT11	0.625	16	2	3055	0.004	24.44	0.050	2230	0.003	13.38	0.025	1190	0.002	4.76	0.005
	0.750	20	3	2550	0.004	30.60	0.050	1860	0.003	16.74	0.025	995	0.002	5.97	0.005
	1.000	25	3	1910	0.004	22.92	0.050	1395	0.003	12.56	0.025	745	0.002	4.47	0.005
			4	1910	0.004	30.56	0.050	1395	0.003	16.74	0.025	745	0.002	5.96	0.005
	1.250	32	3	1530	0.004	18.36	0.050	1115	0.003	10.04	0.025	595	0.002	3.57	0.005
			5	1530	0.004	30.60	0.050	1115	0.003	16.73	0.025	595	0.002	5.95	0.005
	2.000	50	5	955	0.004	19.10	0.050	700	0.003	10.50	0.025	375	0.002	3.75	0.005
			7	955	0.004	26.74	0.050	700	0.003	14.70	0.025	375	0.002	5.25	0.005
	2.500	63	6	765	0.004	18.36	0.050	560	0.003	10.08	0.025	300	0.002	3.60	0.005
			8	765	0.004	24.48	0.050	560	0.003	13.44	0.025	300	0.002	4.80	0.005
3.000	80	7	640	0.004	17.92	0.050	465	0.003	9.77	0.025	250	0.002	3.50	0.005	
		10	640	0.004	25.60	0.050	465	0.003	13.95	0.025	250	0.002	5.00	0.005	
ZDKT15	1.000	25	2	1910	0.005	19.10	0.100	1395	0.004	11.16	0.030	745	0.003	4.47	0.010
	1.250	32	2	1530	0.005	15.30	0.100	1115	0.004	8.92	0.030	595	0.003	3.57	0.010
			3	1530	0.005	22.95	0.100	1115	0.004	13.38	0.030	595	0.003	5.36	0.010
	1.500	40	3	1275	0.005	19.13	0.100	930	0.004	11.16	0.030	500	0.003	4.50	0.010
			4	1275	0.005	25.50	0.100	930	0.004	14.88	0.030	500	0.003	6.00	0.010
	2.000	50	3	955	0.005	14.33	0.100	700	0.004	8.40	0.030	375	0.003	3.38	0.010
			5	955	0.005	23.88	0.100	700	0.004	14.00	0.030	375	0.003	5.63	0.010
	2.500	63	4	765	0.005	15.30	0.100	560	0.004	8.96	0.030	300	0.003	3.60	0.010
			6	765	0.005	22.95	0.100	560	0.004	13.44	0.030	300	0.003	5.40	0.010
	3.000	80	5	640	0.005	16.00	0.100	465	0.004	9.30	0.030	250	0.003	3.75	0.010
			8	640	0.005	25.60	0.100	465	0.004	14.88	0.030	250	0.003	6.00	0.010
	4.000	100	7	480	0.005	16.80	0.100	350	0.004	9.80	0.030	190	0.003	3.99	0.010
			10	480	0.005	24.00	0.100	350	0.004	14.00	0.030	190	0.003	5.70	0.010
	5.000	125	8	385	0.005	15.40	0.100	280	0.004	8.96	0.030	150	0.003	3.60	0.010
11			385	0.005	21.18	0.100	280	0.004	12.32	0.030	150	0.003	4.95	0.010	
6.000	160	10	320	0.005	16.00	0.100	235	0.004	9.40	0.030	125	0.003	3.75	0.010	
		12	320	0.005	19.20	0.100	235	0.004	11.28	0.030	125	0.003	4.50	0.010	

\*Materials hardened to 50-60HRC are very difficult to machine and not recommended.

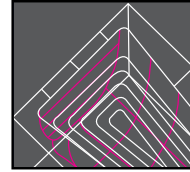
# High Speed Machining Guide

## Machining Tips

- Use Z-Level climb cutting for roughing operations.
- Use Helical for material engagement whenever possible for material entry (See Helical chart for ramp angles and arc limits depending on tool dia.).
- 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.
- LDR of 6xD to 10xD reduce spindle speed by 35% and feed rate by 25% to get started.
- LDR of 10xD and over reduce RPM by 50% and depth of cut by 65% to get started. **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

## Formulas

$$\text{RPM} = (3.82 \times \text{SFM}) / \text{Tool Diameter}$$

$$\text{SFM} = 0.262 \times \text{RPM} \times \text{Tool Diameter}$$

$$\text{IPM} = \text{RPM} \times \# \text{ Flutes} \times \text{Chip Load}$$

$$\text{Chip Load} = \text{IPM} / (\text{RPM} \times \# \text{ Flutes})$$

## Depth of Cut

Adjusting depths of cuts based on LDR (Length Diameter Ratio)

### Axial Depths of Cuts

- Depth of cut should be reduced by 5% per increment of LDR.

### Radial Depths of Cuts

- This cutter performs best with step over amounts 100% to 50% of cutter diameter. Lesser amounts will result in less stability and reduce performance overall.

## Diagnosing Problems

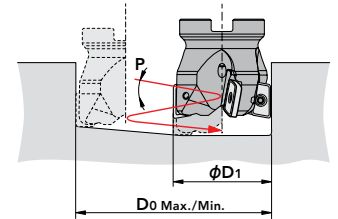
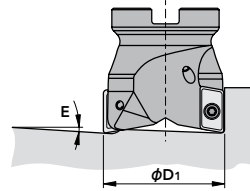
**Insert Chipping** - early during use means chip load too high, please reduce feed rate in increments of 20% until problem is resolved or shorten the length of the tool.

**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.

## Maximum Helical Ramping Angle

Insert Size Diameter (Inch)	ZDKT11				ZDKT15			
	Ramping Angle	Helical Milling (Inch)		Helical Angle	Ramping Angle	Helical Milling (Inch)		Helical Angle
	E	Do Min	Do Max	P	E	Do Min	Do Max	P
0.625	10.8°	0.935	1.187	9.5°	-	-	-	-
0.750	9.8°	1.185	1.437	7.0°	-	-	-	-
1.000	7.4°	1.685	1.927	4.4°	9.5°	1.488	1.921	7.4°
1.250	4.8°	2.158	2.437	3.2°	6.8°	1.988	2.421	5.0°
1.500	2.9°	2.685	2.937	2.2°	5.1°	2.488	2.921	3.2°
2.000	2.1°	3.685	3.937	1.6°	2.4°	3.488	3.921	2.4°
2.500	1.8°	4.685	4.937	1.4°	2.3°	4.488	4.921	1.4°
3.000	1.4°	5.685	5.937	1.0°	2.0°	5.488	5.921	1.3°
4.000	-	-	-	-	1.4°	7.488	7.921	1.0°
5.000	-	-	-	-	0.8°	9.488	9.921	0.8°
6.000	-	-	-	-	0.7°	11.488	11.921	0.6°



## Recommended Materials by Application

Insert Grade	Chip Breaker	Coolant	Carbon Steels	Stainless Steels	Cast Irons	Non-Ferrous	Hi-Temp Alloys	Hardened Steels
			P	M	K	N	S	H
CK010	NM	Yes				⊙		
XC3020	GL / GM / GR	-	⊙		○			
XP3025	GL / GM / GR	Yes	⊙		○			
XC3030	GL / GM / GR	-	⊙		○			
XP3035	GL / GM / GR	-	⊙	○	○			
XP2025	GL / GM	Yes	○	⊙			○	
XP2040	GL / GM / GR	-	○	○				○
		Yes	○	⊙			○	
XC1015	GM / GR	-			⊙			
XC5035	SM	-		⊙				
		Yes		○			○	
XC5040	SM	Yes		○			⊙	
XP6015	HR	-	○		○			⊙

GL: Light Cutting GM: Medium Cutting GR: Heavy Cutting NM: Aluminum SM: Heat Resistant Alloy HR: Hardened Steel

○ good ⊙ best

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