



**PSE 90° Shoulder Cutter**  
**MS Machining Guide**

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

For LDR Greater See LDR Notes

High Speed Machining Guide (Aggressive Parameters)

Material				Stainless Steel (annealed)				Stainless Steel (hardened)				Titanium Alloys				Heat Resistant Alloys (annealed)				Heat Resistant Alloys (hardened)			
Insert Size	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)	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	1985	0.005	19.85	0.050	1620	0.004	12.96	0.050	950	0.005	9.50	0.040	855	0.0025	4.28	0.040	700	0.002	2.80	0.040
	0.750	20	3	1655	0.005	24.83	0.050	1350	0.004	16.20	0.050	790	0.005	11.85	0.040	715	0.0025	5.36	0.040	585	0.002	3.51	0.040
	1.000	25	3	1240	0.005	18.60	0.050	1015	0.004	12.18	0.050	595	0.005	8.93	0.040	535	0.0025	4.01	0.040	440	0.002	2.64	0.040
			4	1240	0.005	24.80	0.050	1015	0.004	16.24	0.050	595	0.005	11.90	0.040	535	0.0025	5.35	0.040	440	0.002	3.52	0.040
	1.250	32	3	995	0.005	14.93	0.050	810	0.004	9.72	0.050	475	0.005	7.13	0.040	430	0.0025	3.23	0.040	350	0.002	2.10	0.040
			5	995	0.005	24.88	0.050	810	0.004	16.20	0.050	475	0.005	11.88	0.040	430	0.0025	5.38	0.040	350	0.002	3.50	0.040
	2.000	50	5	620	0.005	15.50	0.050	510	0.004	10.20	0.050	300	0.005	7.50	0.040	270	0.0025	3.38	0.040	220	0.002	2.20	0.040
			7	620	0.005	21.70	0.050	510	0.004	14.28	0.050	300	0.005	10.50	0.040	270	0.0025	4.73	0.040	220	0.002	3.08	0.040
	2.500	63	6	495	0.005	14.85	0.050	405	0.004	9.72	0.050	240	0.005	7.20	0.040	215	0.0025	3.23	0.040	175	0.002	2.10	0.040
			8	495	0.005	19.80	0.050	405	0.004	12.96	0.050	240	0.005	9.60	0.040	215	0.0025	4.30	0.040	175	0.002	2.80	0.040
	3.000	80	7	415	0.005	14.53	0.050	340	0.004	9.52	0.050	200	0.005	7.00	0.040	180	0.0025	3.15	0.040	150	0.002	2.10	0.040
			10	415	0.005	20.75	0.050	340	0.004	13.60	0.050	200	0.005	10.00	0.040	180	0.0025	4.50	0.040	150	0.002	3.00	0.040
ZDKT15	1.000	25	2	1240	0.006	14.88	0.100	1015	0.005	10.15	0.100	595	0.005	5.95	0.080	535	0.0025	2.68	0.080	440	0.002	1.76	0.080
	1.250	32	2	995	0.006	11.94	0.100	810	0.005	8.10	0.100	475	0.005	4.75	0.080	430	0.0025	2.15	0.080	350	0.002	1.40	0.080
			3	995	0.006	17.91	0.100	810	0.005	12.15	0.100	475	0.005	7.13	0.080	430	0.0025	3.23	0.080	350	0.002	2.10	0.080
	1.500	40	3	830	0.006	14.94	0.100	675	0.005	10.13	0.100	395	0.005	5.93	0.080	360	0.0025	2.70	0.080	295	0.002	1.77	0.080
			4	830	0.006	19.92	0.100	675	0.005	13.50	0.100	395	0.005	7.90	0.080	360	0.0025	3.60	0.080	295	0.002	2.36	0.080
	2.000	50	3	620	0.006	11.16	0.100	510	0.005	7.65	0.100	300	0.005	4.50	0.080	270	0.0025	2.03	0.080	220	0.002	1.32	0.080
			5	620	0.006	18.60	0.100	510	0.005	12.75	0.100	300	0.005	7.50	0.080	270	0.0025	3.38	0.080	220	0.002	2.20	0.080
	2.500	63	4	495	0.006	11.88	0.100	405	0.005	8.10	0.100	240	0.005	4.80	0.080	215	0.0025	2.15	0.080	175	0.002	1.40	0.080
			6	495	0.006	17.82	0.100	405	0.005	12.15	0.100	240	0.005	7.20	0.080	215	0.0025	3.23	0.080	175	0.002	2.10	0.080
	3.000	80	5	415	0.006	12.45	0.100	340	0.005	8.50	0.100	200	0.005	5.00	0.080	180	0.0025	2.25	0.080	150	0.002	1.50	0.080
			8	415	0.006	19.92	0.100	340	0.005	13.60	0.100	200	0.005	8.00	0.080	180	0.0025	3.60	0.080	150	0.002	2.40	0.080
	4.000	100	7	310	0.006	13.02	0.100	255	0.005	8.93	0.100	150	0.005	5.25	0.080	135	0.0025	2.36	0.080	110	0.002	1.54	0.080
			10	310	0.006	18.60	0.100	255	0.005	12.75	0.100	150	0.005	7.50	0.080	135	0.0025	3.38	0.080	110	0.002	2.20	0.080
	5.000	125	8	250	0.006	12.00	0.100	205	0.005	8.20	0.100	120	0.005	4.80	0.080	110	0.0025	2.20	0.080	90	0.002	1.44	0.080
			11	250	0.006	16.50	0.100	205	0.005	11.28	0.100	120	0.005	6.60	0.080	110	0.0025	3.03	0.080	90	0.002	1.98	0.080
	6.000	160	10	210	0.006	12.60	0.100	170	0.005	8.50	0.100	100	0.005	5.00	0.080	90	0.0025	2.25	0.080	75	0.002	1.50	0.080
			12	210	0.006	15.12	0.100	170	0.005	10.20	0.100	100	0.005	6.00	0.080	90	0.0025	2.70	0.080	75	0.002	1.80	0.080

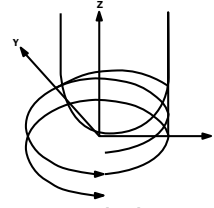
Machining Guide (Moderate Parameters)

Material				Stainless Steel (annealed)				Stainless Steel (hardened)				Titanium Alloys				Heat Resistant Alloys (annealed)				Heat Resistant Alloys (hardened)			
Insert Size	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)	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	1620	0.004	12.96	0.050	1315	0.003	7.89	0.050	795	0.004	6.36	0.050	700	0.002	2.80	0.050	580	0.0016	1.86	0.050
	0.750	20	3	1350	0.004	16.20	0.050	1095	0.003	9.86	0.050	665	0.004	7.98	0.050	585	0.002	3.51	0.050	485	0.0016	2.33	0.050
	1.000	25	3	1015	0.004	12.18	0.050	820	0.003	7.38	0.050	500	0.004	6.00	0.050	440	0.002	2.64	0.050	365	0.0016	1.75	0.050
			4	1015	0.004	16.24	0.050	820	0.003	9.84	0.050	500	0.004	8.00	0.050	440	0.002	3.52	0.050	365	0.0016	2.34	0.050
	1.250	32	3	810	0.004	9.72	0.050	660	0.003	5.94	0.050	400	0.004	4.80	0.050	350	0.002	2.10	0.050	290	0.0016	1.39	0.050
			5	810	0.004	16.20	0.050	660	0.003	9.90	0.050	400	0.004	8.00	0.050	350	0.002	3.50	0.050	290	0.0016	2.32	0.050
	2.000	50	5	510	0.004	10.20	0.050	410	0.003	6.15	0.050	250	0.004	5.00	0.050	220	0.002	2.20	0.050	180	0.0016	1.44	0.050
			7	510	0.004	14.28	0.050	410	0.003	8.61	0.050	250	0.004	7.00	0.050	220	0.002	3.08	0.050	180	0.0016	2.02	0.050
	2.500	63	6	405	0.004	9.72	0.050	330	0.003	5.94	0.050	200	0.004	4.80	0.050	175	0.002	2.10	0.050	145	0.0016	1.39	0.050
			8	405	0.004	12.96	0.050	330	0.003	7.92	0.050	200	0.004	6.40	0.050	175	0.002	2.80	0.050	145	0.0016	1.86	0.050
	3.000	80	7	340	0.004	9.52	0.050	275	0.003	5.78	0.050	165	0.004	4.63	0.050	150	0.002	2.10	0.050	120	0.0016	1.34	0.050
			10	340	0.004	13.60	0.050	275	0.003	8.25	0.050	165	0.004	6.60	0.050	150	0.002	3.00	0.050	120	0.0016	1.92	0.050
ZDKT15	1.000	25	2	1015	0.005	10.15	0.100	820	0.004	6.56	0.100	500	0.004	4.00	0.100	440	0.002	1.76	0.100	365	0.0016	1.17	0.100
	1.250	32	2	810	0.005	8.10	0.100	660	0.004	5.28	0.100	400	0.004	3.20	0.100	350	0.002	1.40	0.100	290	0.0016	0.93	0.100
			3	810	0.005	12.15	0.100	660	0.004	7.92	0.100	400	0.004	4.80	0.100	350	0.002	2.10	0.100	290	0.0016	1.39	0.100
	1.500	40	3	675	0.005	10.13	0.100	550	0.004	6.60	0.100	330	0.004	3.96	0.100	295	0.002	1.77	0.100	240	0.0016	1.15	0.100
			4	675	0.005	13.50	0.100	550	0.004	8.80	0.100	330	0.004	5.28	0.100	295	0.002	2.36	0.100	240	0.0016	1.54	0.100
	2.000	50	3	510	0.005	7.65	0.100	410	0.004	4.92	0.100	250	0.004	3.00	0.100	220	0.002	1.32	0.100	180	0.0016	0.86	0.100
			5	510	0.005	12.75	0.100	410	0.004	8.20	0.100	250	0.004	5.00	0.100	220	0.002</						

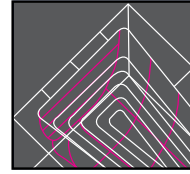
# High Speed Machining Guide

## 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

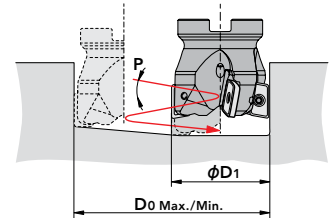
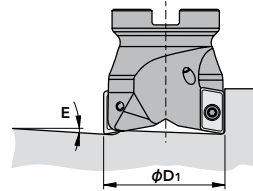
**Insert Chipping** - early during use means chip load too high, please reduce - feed rate in increments of 20% until problem is resolved or shorten the length of the tool.

**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	ZDKT11				ZDKT15			
	Diameter (Inch)	Ramping Angle	Helical Milling (Inch)	Helical Ramping Angle	Diameter (Inch)	Ramping Angle	Helical Milling (Inch)	Helical Ramping Angle
D1	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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