

M9 Series Application Guide (inch) • Speed & Feed

ISO Classification	Work Material	Type of Cut	Axial DOC	Radial DOC	Number of Flutes	Speed (SFM)	Feed (Inches per Tooth)						
							1/8	1/4	3/8	1/2	5/8	3/4	1
P	Low Carbon Steel 1018, 12L14, 8620	Slotting	1 x D	1 x D	4	350	.0006	.0013	.0019	.0026	.0032	.0038	.0051
		Peripheral - Rough	1.25 x D	.5 x D	4	425	.0008	.0016	.0024	.0032	.0040	.0048	.0064
		Peripheral - HEM	2 x D	.15 x D	4	525	.0015	.0031	.0046	.0061	.0077	.0092	.0123
		Finish	1.5 x D	.015 x D	4	500	.0009	.0018	.0027	.0036	.0044	.0053	.0071
	Medium Carbon Steels 4140, 4340	Slotting	1 x D	1 x D	4	300	.0006	.0012	.0018	.0024	.0030	.0036	.0048
		Peripheral - Rough	1.25 x D	.5 x D	4	375	.0008	.0015	.0023	.0030	.0038	.0045	.0060
		Peripheral - HEM	2 x D	.15 x D	4	475	.0014	.0028	.0042	.0056	.0070	.0084	.0112
		Finish	1.5 x D	.015 x D	4	450	.0008	.0017	.0025	.0033	.0042	.0050	.0067
	Martensitic Stainless Steel 416, 410, 440C	Slotting	.75 x D	1 x D	4	300	.0006	.0012	.0018	.0024	.0029	.0035	.0047
		Peripheral - Rough	1.25 x D	.3 x D	4	375	.0007	.0015	.0022	.0029	.0037	.0044	.0059
		Peripheral - HEM	2 x D	.15 x D	4	475	.0014	.0028	.0042	.0056	.0070	.0084	.0112
		Finish	1.5 x D	.015 x D	4	450	.0007	.0015	.0022	.0030	.0037	.0045	.0060
K	Cast Iron Gray	Slotting	1 x D	1 x D	4	325	.0006	.0012	.0018	.0024	.0030	.0036	.0048
		Peripheral - Rough	1.25 x D	.5 x D	4	400	.0008	.0015	.0023	.0030	.0038	.0045	.0060
		Peripheral - HEM	2 x D	.15 x D	4	500	.0013	.0026	.0039	.0053	.0066	.0079	.0105
		Finish	1.5 x D	.015 x D	4	475	.0008	.0017	.0025	.0033	.0042	.0050	.0067
	Cast Iron Ductile	Slotting	1 x D	1 x D	4	300	.0005	.0011	.0016	.0022	.0027	.0032	.0043
		Peripheral - Rough	1.25 x D	.5 x D	4	375	.0007	.0014	.0020	.0027	.0034	.0041	.0054
		Peripheral - HEM	2 x D	.15 x D	4	475	.0011	.0022	.0033	.0044	.0055	.0066	.0088
		Finish	1.5 x D	.015 x D	4	450	.0007	.0015	.0022	.0030	.0037	.0045	.0060
	Cast Iron Malleable	Slotting	.75 x D	1 x D	4	250	.0005	.0011	.0016	.0022	.0027	.0032	.0043
		Peripheral - Rough	1.25 x D	.5 x D	4	325	.0007	.0014	.0020	.0027	.0034	.0041	.0054
		Peripheral - HEM	2 x D	.15 x D	4	425	.0011	.0022	.0033	.0044	.0055	.0066	.0088
		Finish	1.5 x D	.015 x D	4	400	.0007	.0015	.0022	.0030	.0037	.0045	.0060
M	Austenitic Stainless Steels 303, 304, 316	Slotting	.75 x D	1 x D	4	275	.0007	.0013	.0020	.0026	.0033	.0039	.0052
		Peripheral - Rough	1.25 x D	.3 x D	4	325	.0008	.0016	.0025	.0033	.0041	.0049	.0065
		Peripheral - HEM	2 x D	.1 x D	4	425	.0016	.0031	.0047	.0063	.0078	.0094	.0125
		Finish	1.5 x D	.015 x D	4	400	.0008	.0017	.0025	.0033	.0042	.0050	.0067
	Precipitation Hardening Stainless Steels 17-4 PH, 15-5 PH, 13-8 PH	Slotting	.5 x D	1 x D	4	250	.0005	.0010	.0015	.0020	.0025	.0030	.0040
		Peripheral - Rough	1.25 x D	.3 x D	4	300	.0006	.0013	.0019	.0025	.0031	.0038	.0050
		Peripheral - HEM	1.5 x D	.1 x D	4	400	.0013	.0026	.0039	.0052	.0065	.0078	.0104
		Finish	1.5 x D	.015 x D	4	375	.0006	.0013	.0019	.0026	.0032	.0038	.0051
H	Tool & Die Steels < 48 Rc A2, D2, H13, P20	Slotting	.75 x D	1 x D	4	300	.0006	.0012	.0018	.0024	.0029	.0035	.0047
		Peripheral - Rough	1.25 x D	.3 x D	4	375	.0007	.0015	.0022	.0029	.0037	.0044	.0059
		Peripheral - HEM	2 x D	.15 x D	4	475	.0012	.0024	.0035	.0047	.0059	.0071	.0095
		Finish	1.5 x D	.015 x D	4	450	.0007	.0015	.0022	.0030	.0037	.0045	.0060
S	Titanium Alloys	Slotting	.5 x D	1 x D	4	250	.0005	.0010	.0015	.0020	.0025	.0030	.0040
		Peripheral - Rough	1.25 x D	.3 x D	4	300	.0006	.0013	.0019	.0025	.0031	.0038	.0050
		Peripheral - HEM	1.5 x D	.1 x D	4	400	.0012	.0024	.0036	.0048	.0060	.0072	.0096
		Finish	1.5 x D	.015 x D	4	375	.0006	.0013	.0019	.0026	.0032	.0038	.0051
	High Temperature Alloys Inconel, Haynes, Stellite, Hastalloy	Slotting	.25 x D	1 x D	4	60	.0005	.0011	.0016	.0021	.0027	.0032	.0042
		Peripheral - Rough	1.25 x D	.25 x D	4	90	.0007	.0013	.0020	.0027	.0033	.0040	.0053
		Peripheral - HEM	1.5 x D	.1 x D	4	225	.0009	.0018	.0027	.0035	.0044	.0053	.0071
		Finish	1.5 x D	.01 x D	4	125	.0008	.0016	.0023	.0031	.0039	.0047	.0062

D = Tool diameter

Common Machining Formulas

$$RPM = \frac{SFM \times 3.82}{D}$$

$$SFM = RPM \times D \times .262$$

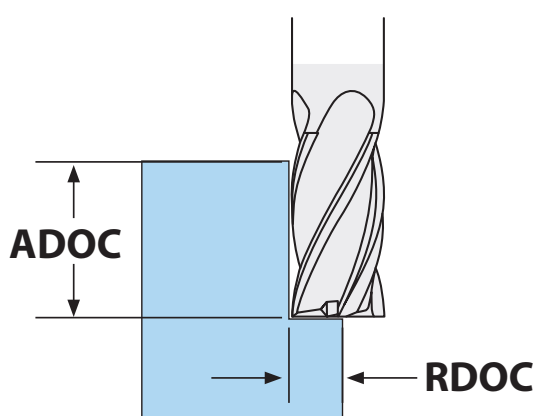
$$IPM = RPM \times IPT \times Z$$

$$MRR = RDOC \times ADOC \times IPM$$

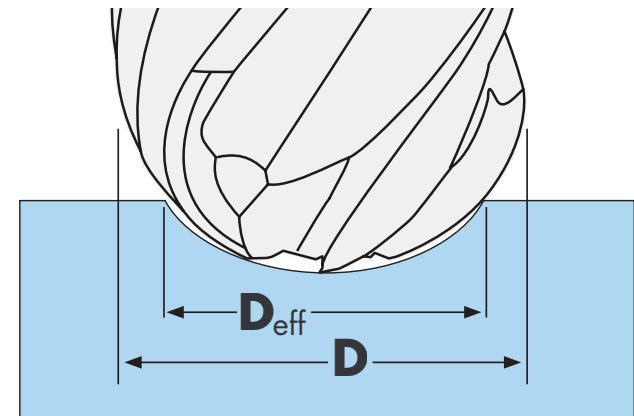
Radial Chip Thinning Adjustment
$$IPT_{adj} = \frac{IPT \times (D/2)}{\sqrt{(D \times RDOC) - RDOC^2}}$$

Ball Nose "Effective Diameter"
$$D_{eff} = 2 \times \sqrt{R^2 - (R - ADOC)^2}$$

- D** Tool Cutting Diameter
- R** Tool Radius
- Z** Number of Flutes
- RPM** Revolutions per Minute
- SFM** Surface Feet per Minute
- IPM** Inches per Minute
- MRR** Metal Removal Rate
- RDOC** Radial Depth of Cut
- ADOC** Axial Depth of Cut

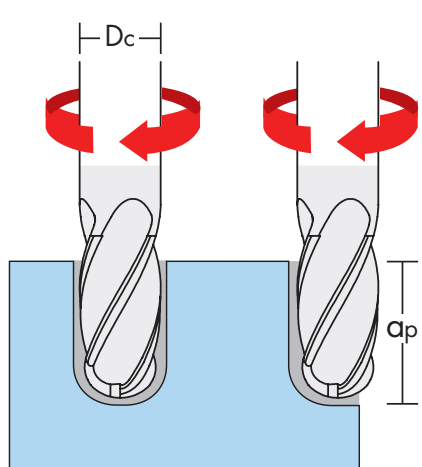


Apply chip thinning adjustment when RDOC < D



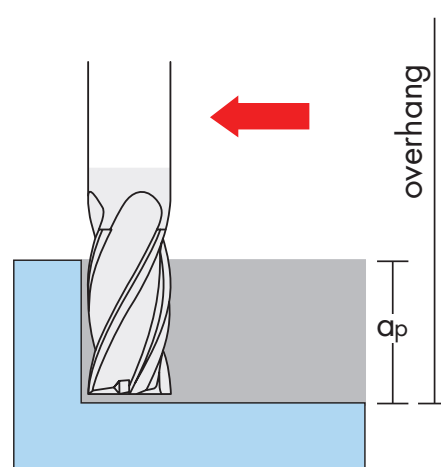
Use D_eff when making shallow cuts with full radius

Adjustments - Apply these adjustments when programming the following applications.



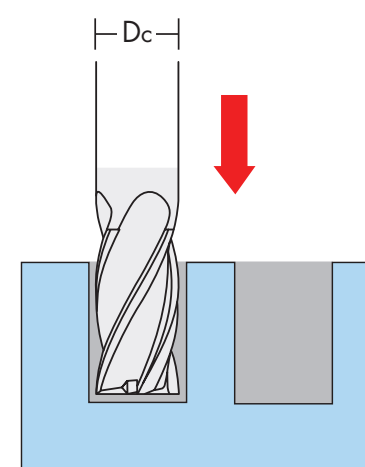
1. Ball nose end mills

- Reduce chip load by 25% from roughing/slotting recommendation when axial DOC (ap) exceeds 75% of Dc



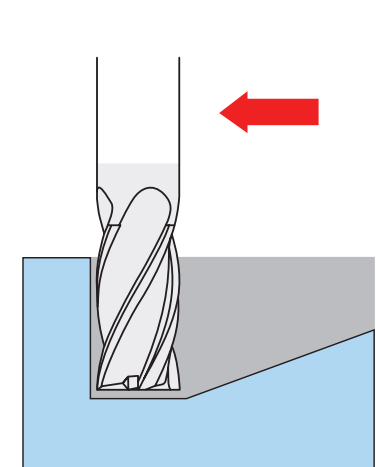
2. Long reach mills with large overhang

- Reduce speed rate and chip load by 20% each when total reach to tool diameter ratio is 5:1 or greater



3. Plunge entry into work piece

- Reduce chip load by 80% of recommended slotting rate
- Peck mill if axial DOC (ap) exceeds 50% of Dc



4. Ramp entry into work piece

- Ramp at 1.5°-2.5° angle
- Reduce chip load by 20% of recommended slotting rate