M525 Series Application Guide (metric) • Speed & Feed

ISO Classification	Work Material	Type of Cut	Axial DOC	Radial DOC	Number of Flutes	Speed (M/Min)	Feed (MM per Tooth) 6,0	10,0	12,0	16,0	20,0	25,0
S	Titanium Alloys	Slotting	.5 x D	1 x D	5	76	0.0234	0.0388	0.0467	0.0622	0.0776	0.0935
	6Al-4V, 6-2-4	Peripheral - Rough	1 x D	.3 x D	5	91	0.0319	0.0529	0.0637	0.0848	0.1058	0.1275
		Peripheral - HEM*	1.5 x D	.1 x D	5	130	0.0609	0.1010	0.1217	0.1619	0.2020	0.2434
		Finish	1.5 x D	.01 x D	5	91	0.0587	0.0975	0.1174	0.1562	0.1949	0.2349
	Difficult to machine Titanium Alloys	Slotting	.25 x D	1 x D	5	61	0.0173	0.0287	0.0345	0.0459	0.0573	0.0691
	10-2-3	Peripheral - Rough	1 x D	.25 x D	5	76	0.0249	0.0414	0.0499	0.0663	0.0828	0.0997
		Peripheral - HEM*	1.5 x D	.1 x D	5	91	0.0450	0.0747	0.0900	0.1196	0.1493	0.1799
		Finish	1.5 x D	.01 x D	5	76	0.0434	0.0720	0.0868	0.1154	0.1441	0.1736
M	Austenitic Stainless Steels, FeNi Alloys	Slotting	.5 x D	1 x D	5	84	0.0305	0.0506	0.0610	0.0811	0.1012	0.1219
	303, 304, 316, Invar, Kovar	Peripheral - Rough	1.25 x D	.3 x D	5	107	0.0416	0.0690	0.0831	0.1106	0.1380	0.1663
		Peripheral - HEM*	2 x D	.1 x D	5	145	0.0794	0.1318	0.1588	0.2111	0.2635	0.3175
		Finish	2 x D	.01 x D	5	107	0.0766	0.1271	0.1532	0.2037	0.2543	0.3063
	Precipitation Hardening Stainless Steels	Slotting	.5 x D	1 x D	5	76	0.0254	0.0422	0.0508	0.0676	0.0843	0.1016
	17-4, 15-5, 13-8	Peripheral - Rough	1.25 x D	.3 x D	5	99	0.0346	0.0575	0.0693	0.0921	0.1150	0.1386
		Peripheral - HEM*	1.5 x D	.1 x D	5	137	0.0661	0.1098	0.1323	0.1759	0.2196	0.2646
		Finish	1.5 x D	.01 x D	5	99	0.0638	0.1059	0.1276	0.1698	0.2119	0.2553
P	Low Carbon Steels <= 38 Rc	Slotting	.5 x D	1 x D	5	99	0.0356	0.0590	0.0711	0.0946	0.1181	0.1422
	1018, 1020, 12L14, 5120, 8620	Peripheral - Rough	1.25 x D	.3 x D	5	122	0.0485	0.0805	0.0970	0.1290	0.1610	0.1940
		Peripheral - HEM*	2 x D	.15 x D	5	160	0.0778	0.1292	0.1556	0.2070	0.2583	0.3112
		Finish	2 x D	.01 x D	5	122	0.0893	0.1483	0.1787	0.2377	0.2966	0.3574
	Medium Carbon Steels <= 48 HRC	Slotting	.5 x D	1 x D	5	91	0.0325	0.0540	0.0650	0.0865	0.1079	0.1300
	1045, 4140, 4340, 5140	Peripheral - Rough	1.25 x D	.3 x D	5	114	0.0443	0.0736	0.0887	0.1179	0.1472	0.1774
		Peripheral - HEM*	2 x	.15 x D	5	152	0.0711	0.1181	0.1423	0.1892	0.2362	0.2845
		Finish	2 x	.01 x D	5	114	0.0817	0.1356	0.1634	0.2173	0.2712	0.3268
	Tool and Die Steels <= 48 Rc	Slotting	.5 x D	1 x D	5	84	0.0274	0.0455	0.0549	0.0730	0.0911	0.1097
	A2, D2, O1, S7, P20, H13	Peripheral - Rough	1.25 x D	.3 x D	5	107	0.0374	0.0621	0.0748	0.0995	0.1242	0.1497
		Peripheral - HEM*	2 x D	.15 x D	5	145	0.0600	0.0996	0.1200	0.1597	0.1993	0.2401
		Finish	2 x D	.01 x D	5	107	0.0689	0.1144	0.1379	0.1833	0.2288	0.2757
	Martensitic & Ferritic Stainless Steels	Slotting	.5 x D	1 x D	5	91	0.0325	0.0540	0.0650	0.0865	0.1079	0.1300
	410, 416, 440	Peripheral - Rough	1.25 x D	.3 x D	5	114	0.0443	0.0736	0.0887	0.1179	0.1472	0.1774
		Peripheral - HEM*	2 x D	.15 x D	5	152	0.0711	0.1181	0.1423	0.1892	0.2362	0.2845
		Finish	2 x D	.01 x D	5	114	0.0817	0.1356	0.1634	0.2173	0.2712	0.3268
K	Cast Iron	Slotting	.5 x D	1 x D	5	91	0.0305	0.0506	0.0610	0.0811	0.1012	0.1219
	Gray	Peripheral - Rough	1.25 x D	.3 x D	5	114	0.0416	0.0690	0.0831	0.1106	0.1380	0.1663
		Finish	2 x D	.01 x D	5	114	0.0766	0.1271	0.1532	0.2037	0.2543	0.3063
	Cast Iron	Slotting	.5 x D	1 x D	5	84	0.0254	0.0422	0.0508	0.0676	0.0843	0.1016
	Malleable	Peripheral - Rough	1.25 x D	.3 x D	5	107	0.0346	0.0575	0.0693	0.0921	0.1150	0.1386
		Peripheral - HEM*	2 x D	.15 x D	5	145	0.0556	0.0923	0.1111	0.1478	0.1845	0.2223
		Finish	2 x D	.01 x D	5	107	0.0638	0.1059	0.1276	0.1698	0.2119	0.2553

D = Tool Diameter   *HEM= High-efficiency machining (chip thinning calculations have already been applied to HEM parameters shown)

Common Machining Formulas

$$RPM = \frac{M/MIN \times 318.057}{D}$$

$$M/MIN = RPM \times D \times .00314$$

$$MM/MIN = RPM \times MMPT \times Z$$

$$MRR = RDOC \times ADOC \times MM/MIN$$

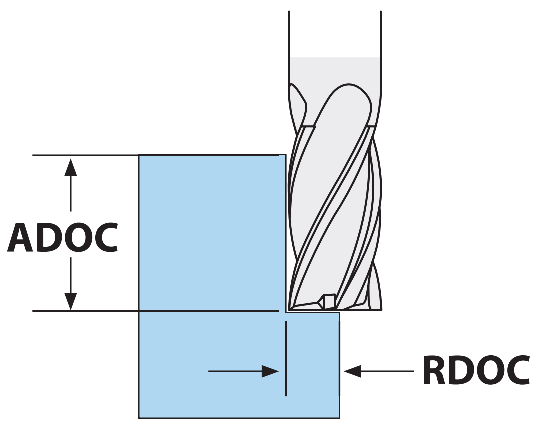
Radial Chip Thinning Adjustment

$$MMPT_{adj} = \frac{MMPT \times (D/2)}{\sqrt{(D \times RDOC) - RDOC^2}}$$

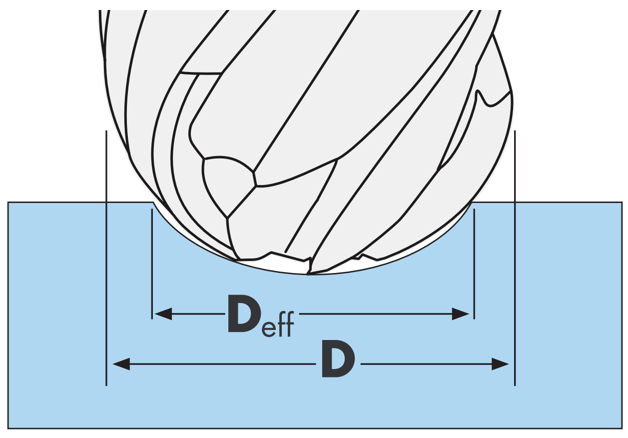
Ball Nose "Effective Diameter"

$$D_{eff} = 2x \sqrt{R^2 - (R - ADOC)^2}$$

D	Tool Cutting Diameter
R	Tool Radius
Z	Number of Flutes
RPM	Revolutions per Minute
M/MIN	Meters per Minute
MM/Min	Millimeters per Minute
MRR	Metal Removal Rate
RDOC	Radial Depth of Cut
ADOC	Axial Depth of Cut

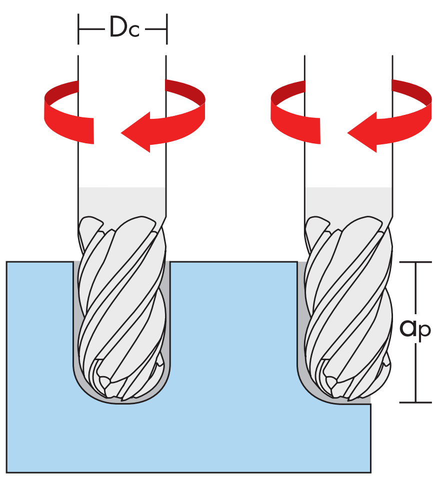


Apply chip thinning adjustment when RDOC < D



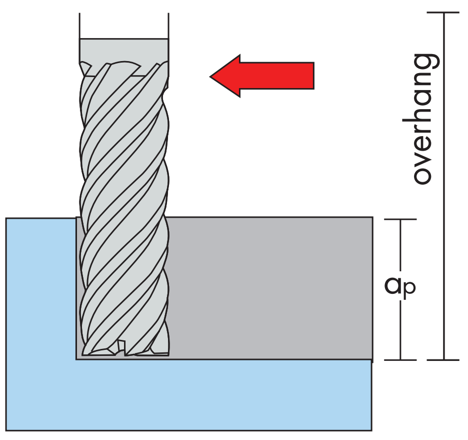
Use D_{eff} when making shallow cuts with full radius

Adjustments – Apply these adjustments when programming the following applications.



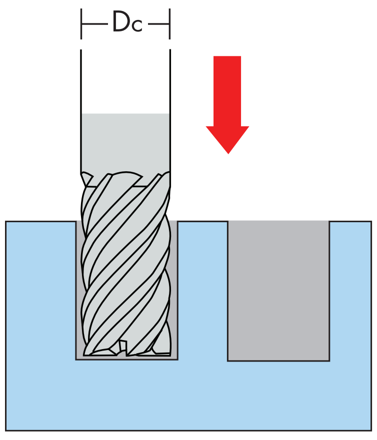
1. Ball end mills

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



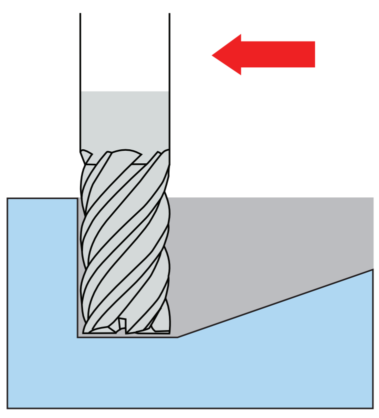
2. Long reach mills with large overhang

- Reduce speed rate and chipload by 10%



3. Plunge entry into work piece

- Reduce chipload 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 chipload by 20% of recommended slotting rate