

Speeds and Feeds



- 1) Select your material in the ISO colored chart.
- 2) Start with the appropriate feed per tooth, f_z (in) for your application. Start with a middle/average value for cutting speed, V_c (ft/min). Adjust the cutting speeds and/or feed based on your cutting conditions.

			Engraving Ball End Mill - TiAlN Coated		
Material			Recommended Cutting Values		
Group	VDI 3323	Material Description	Parameter	Tool Diameter (mm)	
ISO				3	
				Rough Profile	Finish Profile
P	1-5	Steel - Non-alloy, Cast & Free Cutting Annealed, Hardened and Tempered 125 - 300 HB	Vc, SMM	350	350
			Fz, MMPT	0.0004	0.0006
			n, RPM	11320	11320
			Vf, MPPM	9	14
	6-9	Steel - Low Alloy & Cast Annealed, Hardened and Tempered 180 - 350 HB	Vc, SMM	350	350
			Fz, MMPT	0.0004	0.0006
			n, RPM	11320	11320
			Vf, MPPM	9	14
	10	Steel - High Alloy, Cast & Tool Annealed 200 HB	Vc, SMM	350	350
			Fz, MMPT	0.0004	0.0006
			n, RPM	11320	11320
			Vf, MPPM	9	14
	11.1	Steel - Bainitic Ultra-High-Carbon Bainitically Hardened 260 - 480 HB	Vc, SMM	350	350
			Fz, MMPT	0.0004	0.0006
			n, RPM	11320	11320
			Vf, MPPM	9	14
M	12-13	Stainless Steel Hardened and Tempered 200 - 240 HB	Vc, SMM	195	195
			Fz, MMPT	0.0002	0.0004
			n, RPM	6310	6310
			Vf, MPPM	3	5
	14.1-14.2	Stainless Steel Precipitation Hardened, Solution Annealed 250 HB	Vc, SMM	195	195
			Fz, MMPT	0.0002	0.0004
			n, RPM	6310	6310
			Vf, MPPM	3	5

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Cutting conditions:

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ISO	VDI 3323			3		
				Rough Profile	Finish Profile	
K	15-16	Cast Iron - Gray (GCI) 180 - 260 HB	Vc, SMM	325	325	
			Fz, MMPT	0.0004	0.0008	
			n, RPM	10510	10510	
			Vf, MMPM	8	17	
	17-18	Ductile Iron - Nodular Graphite (GJS) 160 - 250 HB	Vc, SMM	325	325	
			Fz, MMPT	0.0004	0.0008	
			n, RPM	10510	10510	
			Vf, MMPM	8	17	
	19-20	Cast Iron - Malleable 130 - 230 HB	Vc, SMM	325	325	
			Fz, MMPT	0.0004	0.0008	
			n, RPM	10510	10510	
			Vf, MMPM	8	17	
S	31-35	Heat Resistant, Super Alloys Annealed, Hardened, Cast 200 - 350 HB	Vc, SMM	70	70	
			Fz, MMPT	0.0002	0.0004	
			n, RPM	2260	2260	
			Vf, MMPM	1	2	
	36-37	Titanium & Ti Alloys Hardened 400 - 1050 Rm*	Vc, SMM	180	180	
			Fz, MMPT	0.0002	0.0004	
			n, RPM	5820	5820	
			Vf, MMPM	2	5	

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ISO	VDI 3323			3	
				Rough Profile	Finish Profile
H	38.1-38.2	Hardened Steel 419 - 552 HB	Vc, SMM	105	105
			Fz, MMPT	0.0008	0.0009
			n, RPM	3400	3400
			Vf, MPPM	5	6
	39.1-39.3	Hardened Steel Hardened and Tempered 601 - 658 HB, > 60 HRC*	Vc, SMM	105	105
			Fz, MMPT	0.0008	0.0009
			n, RPM	3400	3400
			Vf, MPPM	5	6
	40	Cast Iron Chilled 400 HB	Vc, SMM	105	105
			Fz, MMPT	0.0008	0.0009
			n, RPM	3400	3400
			Vf, MPPM	5	6
	41	Cast Iron Hardened 552 HB	Vc, SMM	105	105
			Fz, MMPT	0.0008	0.0009
			n, RPM	3400	3400
			Vf, MPPM	5	6

Speeds and Feeds



**Feed Rate, Per Revolution
(mm/min)**

$$v_f = f_n \cdot n$$

**Feed Rate, Per Tooth
(mm/min)**

$$v_f = f_z \cdot n \cdot Z$$

**Feed Per Revolution
(mm/rev)**

$$f_n = \frac{v_f}{n}$$

**Feed Per Tooth
(mm)**

$$f_z = \frac{v_f}{n \cdot Z}$$

**Cutting Speed
(m/min)**

$$v_c = \frac{\pi \cdot D_{tool} \cdot n}{1000}$$

**Spindle Speed
(rev/min)**

$$n = \frac{v_c \cdot 1000}{\pi \cdot D_{tool}}$$

**Material Removal Rate
(cm³/min)**

$$MMR = \frac{a_p \cdot a_e \cdot v_f}{1000}$$

Metric

Symbol	Definition	Unit
V_f	Feed rate	mm/min
f_n	Feed per revolution	mm/rev
f_z	Feed per tooth	mm
V_c	Cutting speed	m/min (SMM)
n	Spindle speed	rev/min (RPM)
D_{tool}	Tool cutting diameter	mm
MMR	Material removal rate	(cm³/min)
a_e	Radial depth of cut	mm
a_p	Axial depth of cut	mm
Z	Number of teeth/flutes	