

Speeds and Feeds



Feed: mm/rev
RPM: rev/min

ISO	VDI 3323	Material Description	Composition / Structure / Heat Treatment		HB	HRC		Vc(m/min)		Drill Diameter(mm)	Vc(m/min)		Drill Diameter (mm)						
								1			2	3	4	6	8	10	13		
P	1	Non-alloy steel	About 0.15% C	Annealed	125			28	RPM 8,910 FEED 0.01-0.03	40	RPM 6,370 FEED 0.04-0.08	4,240	3,180	2,120	1,590	1,270	980		
P	2		About 0.45% C	Annealed	190	13		25	RPM 7,960 FEED 0.01-0.03	35	RPM 5,570 FEED 0.04-0.08	3,710	2,790	1,860	1,390	1,110	860		
P	3		About 0.45% C	Quenched & tempered	250	25		20	RPM 6,370 FEED 0.01-0.03	30	RPM 4,770 FEED 0.04-0.08	3,180	2,390	1,590	1,190	950	730		
P	4		About 0.75% C	Annealed	270	28	o	15	RPM 4,770 FEED 0.01-0.02	20	RPM 3,180 FEED 0.02-0.05	2,120	1,590	1,060	800	640	490		
P	5		About 0.75% C	Quenched & tempered	300	32													
P	6	Low alloy steel		Annealed	180	10		25	RPM 7,960 FEED 0.01-0.03	35	RPM 5,570 FEED 0.04-0.08	3,710	2,790	1,860	1,390	1,110	860		
P	7			Quenched & tempered	275	29	o	20	RPM 6,370 FEED 0.01-0.03	30	RPM 4,770 FEED 0.04-0.08	3,180	2,390	1,590	1,190	950	730		
P	8			Quenched & tempered	300	32	o	20	RPM 6,370 FEED 0.01-0.02	30	RPM 4,770 FEED 0.02-0.05	3,180	2,390	1,590	1,190	950	730		
P	9			Quenched & tempered	350	38													
P	10	High alloyed steel, and tool steel		Annealed	200	15	o	15	RPM 4,770 FEED 0.01-0.03	20	RPM 3,180 FEED 0.04-0.08	2,120	1,590	1,060	800	640	490		
P	11			Quenched & Tempered	325	35													
M	12	Stainless steel	Ferritic / Martensitic	Annealed	200	15		18	RPM 5,730 FEED 0.01-0.03	25	RPM 3,980 FEED 0.04-0.08	2,650	1,990	1,330	990	800	610		
M	13		Martensitic	Quenched & Tempered	240	23	o	15	RPM 4,770 FEED 0.01-0.03	20	RPM 3,180 FEED 0.04-0.08	2,120	1,590	1,060	800	640	490		
M	14		Austenitic		180	10	o	10	RPM 3,180 FEED 0.01-0.02	15	RPM 2,390 FEED 0.02-0.05	1,590	1,190	800	600	480	370		
K	15	Grey cast iron	Pearlitic / ferritic		180	10	o	28	RPM 8,910 FEED 0.01-0.03	40	RPM 6,370 FEED 0.04-0.08	4,240	3,180	2,120	1,590	1,270	980		
K	16		Pearlitic (Martensitic)		260	26	o	25	RPM 7,960 FEED 0.01-0.02	35	RPM 5,570 FEED 0.02-0.05	3,710	2,790	1,860	1,390	1,110	860		
K	17	Nodular cast iron	Ferritic		160	3	o	28	RPM 8,910 FEED 0.01-0.03	40	RPM 6,370 FEED 0.04-0.08	4,240	3,180	2,120	1,590	1,270	980		
K	18		Pearlitic		250	25		20	RPM 6,370 FEED 0.01-0.02	30	RPM 4,770 FEED 0.02-0.05	3,180	2,390	1,590	1,190	950	730		
K	19	Malleable cast iron	Ferritic		130		o	25	RPM 7,960 FEED 0.01-0.03	35	RPM 5,570 FEED 0.04-0.08	3,710	2,790	1,860	1,390	1,110	860		
K	20		Pearlitic		230	21		20	RPM 6,370 FEED 0.01-0.02	30	RPM 4,770 FEED 0.02-0.05	3,180	2,390	1,590	1,190	950	730		



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									1			2	3	4	6	8	10	13
N	21	Aluminum-wrought alloy	Not Curable		60		o	45	RPM 14,320	65	RPM 10,350	6,900	5,170	3,450	2,590	2,070	1,590	
									FEED 0.02-0.05		FEED 0.05-0.09	0.07-0.11	0.12-0.16	0.12-0.18	0.14-0.20	0.16-0.22	0.22-0.28	
N	22		Curable	Hardened	100		o	45	RPM 14,320	65	RPM 10,350	6,900	5,170	3,450	2,590	2,070	1,590	
								FEED 0.02-0.05		FEED 0.05-0.09	0.07-0.11	0.12-0.16	0.12-0.18	0.14-0.20	0.16-0.22	0.22-0.28		
N	23	Aluminum-cast, alloyed	≤ 12% Si, Not Curable		75		o	35	RPM 11,140	50	RPM 7,960	5,310	3,980	2,650	1,990	1,590	1,220	
N	24			≤ 12% Si, Curable	Hardened	90												
N	25			> 12% Si, Not Curable		130												
N	26	Copper and Copper Alloys (Bronze / Brass)	Cutting Alloys, PB>1%		110													
N	27			CuZn, CuSnZn (Brass)		90												
N	28			CuSn, lead-free copper and electrolytic copper		100												
N	29	Non Metallic Materials	Duroplastic, Fiber Reinforced Plastic				o	20	RPM 6,370	30	RPM 4,770	3,180	2,390	1,590	1,190	950	730	
N	30			Rubber, Wood, etc.					FEED 0.01-0.03		FEED 0.04-0.08	0.06-0.10	0.08-0.12	0.12-0.16	0.12-0.18	0.16-0.22	0.18-0.24	
S	31	Heat Resistant Super Alloys	Fe Based	Annealed	200	15												
S	32				Cured	280	30											
S	33		Ni or Co Based	Annealed	250	25												
S	34				Cured	350	38											
S	35				Cast	320	34											
S	36	Titanium Alloys	Pure Titanium		400 Rm		o	15	RPM 4,770	20	RPM 3,180	2,120	1,590	1,060	800	640	490	
S	37			Alpha + Beta Alloys	Hardened	1050 Rm			FEED 0.01-0.02		FEED 0.02-0.05	0.02-0.06	0.04-0.08	0.05-0.09	0.06-0.10	0.07-0.13	0.08-0.14	
H	38	Hardened steel		Hardened	550	55												
H	39.1				Hardened	630	60											
H	40	Chilled Cast Iron		Cast	400	42												
H	41	Hardened Cast Iron		Hardened	550	55												



Speeds and Feeds



**Penetration Rate
(mm/min)**

$$v_f = f_n \cdot n$$

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

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

**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)**

$$MRR = \frac{D_{tool} \cdot f_n \cdot v_c}{4}$$

Metric

Symbol	Definition	Unit
v_f	Penetration rate	mm/min
f_n	Feed per revolution	mm/rev
v_c	Cutting speed	m/min (SMM)
n	Spindle speed	rev/min (RPM)
D_{tool}	Tool cutting diameter	mm
MRR	Material removal rate	(cm ³ /min)

Speeds and Feeds



**Penetration Rate
(in/min)**

$$v_f = f_n \cdot n$$

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

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

**Cutting Speed
(ft/min)**

$$v_c = \frac{\pi \cdot D_{tool} \cdot n}{12}$$

**Spindle Speed
(rev/min)**

$$n = \frac{v_c \cdot 12}{\pi \cdot D_{tool}}$$

**Material Removal Rate
(in³/min)**

$$MRR = D_{tool} \cdot f_n \cdot v_c \cdot 3$$

Inch

Symbol	Definition	Unit
v_f	Penetration rate	<i>in/min</i>
f_n	Feed per revolution	<i>in/rev</i>
v_c	Cutting speed	<i>ft/min (SFM)</i>
n	Spindle speed	<i>rev/min (RPM)</i>
D_{tool}	Tool cutting diameter	<i>in</i>
MRR	Material removal rate	<i>(in³/min)</i>