

Speeds and Feeds



ISO	VDI 3323	Material Description	Composition / Structure / Heat Treatment		HB	HRC	Recommended Cutting Values						
								Speed Vc (m/min)	Feed(mm/rev)				
									Reamer Diameter (mm)				
									2	4	6	8	10
P	1	Non-alloy steel	About 0.15% C	Annealed	125		◎	18	0.08~0.10	0.10~0.12	0.12~0.16	0.16~0.20	0.20~0.24
P	2		About 0.45% C	Annealed	190	13	◎	17	0.08~0.10	0.10~0.12	0.12~0.16	0.16~0.20	0.20~0.24
P	3		About 0.45% C	Quenched & tempered	250	25	◎	15	0.08~0.10	0.10~0.12	0.12~0.16	0.16~0.20	0.20~0.24
P	4		About 0.75% C	Annealed	270	28	○	15	0.08~0.10	0.10~0.12	0.12~0.16	0.16~0.20	0.20~0.24
P	5		About 0.75% C	Quenched & tempered	300	32	○	15	0.08~0.10	0.10~0.12	0.12~0.16	0.16~0.20	0.20~0.24
P	6	Low alloy steel		Annealed	180	10	◎	17	0.06~0.08	0.08~0.10	0.10~0.12	0.12~0.15	0.15~0.18
P	7			Quenched & tempered	275	29	◎	14	0.06~0.08	0.08~0.10	0.10~0.12	0.12~0.15	0.15~0.18
P	8			Quenched & tempered	300	32	○	14	0.06~0.08	0.08~0.10	0.10~0.12	0.12~0.15	0.15~0.18
P	9			Quenched & tempered	350	38							
P	10	High alloyed steel, and tool steel		Annealed	200	15	○	13	0.06~0.08	0.08~0.10	0.10~0.12	0.12~0.15	0.15~0.18
P	11			Quenched & Tempered	325	35							
M	12	Stainless steel	Ferritic / Martensitic	Annealed	200	15	○	8	0.06~0.08	0.08~0.10	0.10~0.12	0.12~0.15	0.15~0.18
M	13		Martensitic	Quenched & Tempered	240	23	○	7	0.06~0.08	0.08~0.10	0.10~0.12	0.12~0.15	0.15~0.18
M	14			Austenitic	180	10	○	6	0.06~0.08	0.08~0.10	0.10~0.12	0.12~0.15	0.15~0.18
K	15	Grey cast iron	Pearlitic / ferritic		180	10	◎	20	0.08~0.10	0.10~0.12	0.12~0.16	0.16~0.20	0.20~0.24
K	16		Pearlitic (Martensitic)		260	26	○	15	0.08~0.10	0.10~0.12	0.12~0.16	0.16~0.20	0.20~0.24
K	17	Nodular cast iron	Ferritic		160	3	◎	18	0.08~0.10	0.10~0.12	0.12~0.16	0.16~0.20	0.20~0.24
K	18		Pearlitic		250	25	○	13	0.08~0.10	0.10~0.12	0.12~0.16	0.16~0.20	0.20~0.24
K	19	Malleable cast iron	Ferritic		130		◎	18	0.08~0.10	0.10~0.12	0.12~0.16	0.16~0.20	0.20~0.24
K	20		Pearlitic		230	21	○	13	0.08~0.10	0.10~0.12	0.12~0.16	0.16~0.20	0.20~0.24
N	21	Aluminum-wrought alloy	Not Curable		60		○	30	0.10~0.13	0.13~0.16	0.16~0.20	0.20~0.25	0.25~0.30
N	22		Curable	Hardened	100		○	30	0.10~0.13	0.13~0.16	0.16~0.20	0.20~0.25	0.25~0.30
N	23	Aluminum-cast, alloyed	≤ 12% Si, Not Curable		75		○	30	0.10~0.13	0.13~0.16	0.16~0.20	0.20~0.25	0.25~0.30
N	24		≤ 12% Si, Curable	Hardened	90		○	25	0.10~0.13	0.13~0.16	0.16~0.20	0.20~0.25	0.25~0.30
N	25		> 12% Si, Not Curable		130								
N	26	Copper and Copper Alloys (Bronze / Brass)	Cutting Alloys, PB>1%		110		○	25	0.10~0.13	0.13~0.16	0.16~0.20	0.20~0.25	0.25~0.30
N	27		CuZn, CuSnZn (Brass)		90		○	22	0.10~0.13	0.13~0.16	0.16~0.20	0.20~0.25	0.25~0.30
N	28		CuSn, lead-free copper and electrolytic copper		100		○	23	0.10~0.13	0.13~0.16	0.16~0.20	0.20~0.25	0.25~0.30

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	