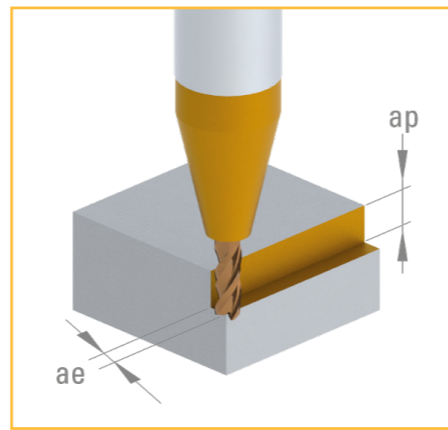


CUTTING CONDITIONS - ROUTING FINISHING



$$n \text{ [tr/min]} = \frac{Vc \text{ [m/min]} \times 1000}{\pi \times D_1 \text{ [mm]}}$$

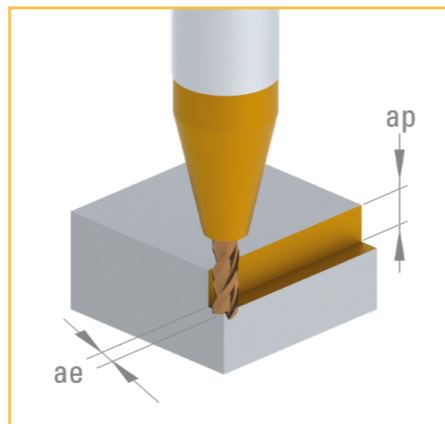
$$Vf \text{ [mm/min]} = n \text{ [tr/min]} \times fz \text{ [mm]} \times Z$$

Materials to be machined		Ø 0.30 - 0.80		Ø 0.80 - 1.60		Ø 1.60 - 5.00	
		CARBIDE	C-TOP	CARBIDE	C-TOP	CARBIDE	C-TOP
		Vc [m/min]	Vc [m/min]	Vc [m/min]	Vc [m/min]	Vc [m/min]	Vc [m/min]
P	Unalloyed steel / Low alloyed steel	< 600 N/mm ²	35 - 120		110 - 200		200 - 260
P	Unalloyed steel / Low alloyed steel	600 – 1500 N/mm ²	25 - 100		80 - 170		160 - 200
P	Lead alloyed cutting steel		40 - 130		120 - 200		220 - 280
P	High alloyed steel	700 – 1500 N/mm ²	20 - 80		70 - 120		100 - 190
M	Stainless steel	400 – 700 N/mm ²	30 - 85		85 - 190		190 - 260
M	DUPLEX stainless steel	> 800 N/mm ²	25 - 65		65 - 145		155 - 220
K	Grey cast iron / Nodular pearlitic iron	< 250 HB	35 - 45	35 - 95	55 - 135	120 - 200	80 - 165
K	Alloyed cast iron / Nodular pearlitic iron	> 250 HB	30 - 40	35 - 80	50 - 110	90 - 150	70 - 140
K	Nodular ferritic cast iron / Malleable cast iron		25 - 35	35 - 75	45 - 100	85 - 125	65 - 120
S	Special alloys / Heat resistant stainless steel	Inconel Nimonic Hastelloy	20 - 35		60 - 100		90 - 130
S	Titanium, titanium alloys		20 - 40	35 - 45	40 - 90	80 - 150	60 - 130
N	Copper alloys - easy to machine (brass - bronze)		40 - 60	45 - 120	60 - 110	120 - 200	90 - 165
N	Copper alloys - difficult to machine / Aluminium bronze	(CuAlFe) (Ampco)	30 - 50	45 - 90	45 - 105	90 - 180	70 - 160
N	Gold, silver		35 - 55	45 - 90	60 - 105	90 - 180	85 - 180

Ø 0.30 - 0.50		Ø 0.50 - 0.80		Ø 0.80 - 1.60		Ø 1.60 - 3.00		Ø 3.00 - 5.00	
fz	ae ap	fz	ae ap	fz	ae ap	fz	ae ap	fz	ae ap
0.004 - 0.007	< 0.15 x Ø < 2.00 x Ø	0.005 - 0.011	< 0.20 x Ø < 2.00 x Ø	0.007 - 0.019	< 0.30 x Ø < 2.00 x Ø	0.013 - 0.040	< 0.30 x Ø < 2.00 x Ø	0.019 - 0.047	< 0.30 x Ø < 2.00 x Ø
0.004 - 0.006	< 0.15 x Ø < 2.00 x Ø	0.005 - 0.010	< 0.25 x Ø < 2.00 x Ø	0.006 - 0.017	< 0.30 x Ø < 2.00 x Ø	0.011 - 0.035	< 0.30 x Ø < 2.00 x Ø	0.016 - 0.041	< 0.30 x Ø < 2.00 x Ø
0.005 - 0.008	< 0.15 x Ø < 2.00 x Ø	0.006 - 0.014	< 0.20 x Ø < 2.00 x Ø	0.008 - 0.023	< 0.30 x Ø < 2.00 x Ø	0.015 - 0.048	< 0.30 x Ø < 2.00 x Ø	0.022 - 0.056	< 0.30 x Ø < 2.00 x Ø
0.004 - 0.005	< 0.15 x Ø < 2.00 x Ø	0.004 - 0.009	< 0.20 x Ø < 2.00 x Ø	0.006 - 0.015	< 0.30 x Ø < 2.00 x Ø	0.010 - 0.032	< 0.30 x Ø < 2.00 x Ø	0.015 - 0.037	< 0.30 x Ø < 2.00 x Ø
0.004 - 0.005	< 0.15 x Ø < 2.00 x Ø	0.004 - 0.009	< 0.20 x Ø < 2.00 x Ø	0.006 - 0.015	< 0.25 x Ø < 2.00 x Ø	0.010 - 0.032	< 0.30 x Ø < 2.00 x Ø	0.015 - 0.037	< 0.30 x Ø < 2.00 x Ø
0.002 - 0.004	< 0.10 x Ø < 2.00 x Ø	0.003 - 0.007	< 0.15 x Ø < 2.00 x Ø	0.005 - 0.011	< 0.30 x Ø < 2.00 x Ø	0.008 - 0.024	< 0.25 x Ø < 2.00 x Ø	0.011 - 0.028	< 0.30 x Ø < 2.00 x Ø
0.005 - 0.008	< 0.15 x Ø < 2.00 x Ø	0.006 - 0.014	< 0.25 x Ø < 2.00 x Ø	0.009 - 0.023	< 0.30 x Ø < 2.00 x Ø	0.015 - 0.048	< 0.30 x Ø < 2.00 x Ø	0.022 - 0.056	< 0.30 x Ø < 2.00 x Ø
0.004 - 0.006	< 0.15 x Ø < 2.00 x Ø	0.005 - 0.010	< 0.20 x Ø < 2.00 x Ø	0.008 - 0.017	< 0.30 x Ø < 2.00 x Ø	0.011 - 0.035	< 0.30 x Ø < 2.00 x Ø	0.016 - 0.041	< 0.30 x Ø < 2.00 x Ø
0.004 - 0.006	< 0.15 x Ø < 2.00 x Ø	0.005 - 0.010	< 0.20 x Ø < 2.00 x Ø	0.008 - 0.017	< 0.30 x Ø < 2.00 x Ø	0.011 - 0.035	< 0.30 x Ø < 2.00 x Ø	0.016 - 0.041	< 0.30 x Ø < 2.00 x Ø
0.002 - 0.003	< 0.10 x Ø < 2.00 x Ø	0.002 - 0.005	< 0.10 x Ø < 2.00 x Ø	0.003 - 0.008	< 0.20 x Ø < 2.00 x Ø	0.005 - 0.016	< 0.20 x Ø < 2.00 x Ø	0.007 - 0.019	< 0.25 x Ø < 2.00 x Ø
0.005 - 0.007	< 0.15 x Ø < 2.00 x Ø	0.006 - 0.011	< 0.15 x Ø < 2.00 x Ø	0.008 - 0.019	< 0.30 x Ø < 2.00 x Ø	0.013 - 0.040	< 0.30 x Ø < 2.00 x Ø	0.019 - 0.047	< 0.30 x Ø < 2.00 x Ø
0.007 - 0.011	< 0.15 x Ø < 2.00 x Ø	0.009 - 0.018	< 0.25 x Ø < 2.00 x Ø	0.012 - 0.030	< 0.30 x Ø < 2.00 x Ø	0.020 - 0.064	< 0.30 x Ø < 2.00 x Ø	0.030 - 0.075	< 0.30 x Ø < 2.00 x Ø
0.005 - 0.007	< 0.20 x Ø < 2.00 x Ø	0.006 - 0.011	< 0.30 x Ø < 2.00 x Ø	0.008 - 0.019	< 0.30 x Ø < 2.00 x Ø	0.013 - 0.040	< 0.30 x Ø < 2.00 x Ø	0.019 - 0.047	< 0.30 x Ø < 2.00 x Ø
0.005 - 0.007	< 0.20 x Ø < 2.00 x Ø	0.006 - 0.012	< 0.30 x Ø < 2.00 x Ø	0.008 - 0.022	< 0.30 x Ø < 2.00 x Ø	0.013 - 0.040	< 0.30 x Ø < 2.00 x Ø	0.019 - 0.047	< 0.30 x Ø < 2.00 x Ø

CUTTING CONDITIONS - ROUGHING CONTOURING

Maximum chip throughput Q (cm³/min)



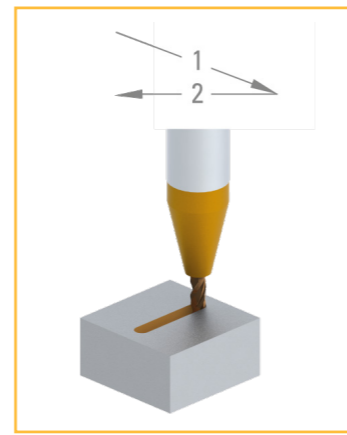
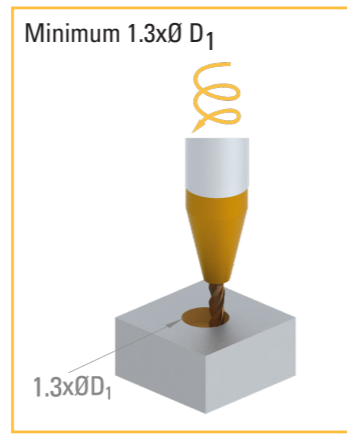
$$n \text{ [tr/min]} = \frac{Vc \text{ [m/min]} \times 1000}{\pi \times D_1 \text{ [mm]}}$$

$$Vf \text{ [mm/min]} = n \text{ [tr/min]} \times fz \text{ [mm]} \times Z$$

Materials to be machined		Ø 0.30 - 0.80		Ø 0.80 - 1.60		Ø 1.60 - 5.00	
		CARBIDE	C-TOP	CARBIDE	C-TOP	CARBIDE	C-TOP
		Vc [m/min]	Vc [m/min]	Vc [m/min]	Vc [m/min]	Vc [m/min]	Vc [m/min]
P	Unalloyed steel / Low alloyed steel	< 600 N/mm ²	25 - 45		40 - 130		120 - 280
P	Unalloyed steel / Low alloyed steel	600 – 1500 N/mm ²	25 - 45		40 - 120		90 - 230
P	Lead alloyed cutting steel		30 - 50		45 - 130		110 - 280
P	High alloyed steel	700 – 1500 N/mm ²	20 - 45		40 - 110		90 - 190
M	Stainless steel	400 – 700 N/mm ²	25 - 50		45 - 120		100 - 230
M	DUPLEX stainless steel	> 800 N/mm ²	15 - 35		30 - 90		75 - 180
K	Grey cast iron / Nodular pearlitic iron	< 250 HB	25 - 45	30 - 90	45 - 125	80 - 180	70 - 165
K	Alloyed cast iron / Nodular pearlitic iron	> 250 HB	20 - 40	30 - 80	40 - 100	70 - 150	60 - 140
K	Nodular ferritic cast iron / Malleable cast iron		20 - 35	30 - 70	35 - 90	60 - 125	55 - 120
S	Special alloys / Heat resistant stainless steel	Inconel Nimonic Hastelloy	20 - 30		30 - 80		60 - 140
S	Titanium, titanium alloys		20 - 40	30 - 45	30 - 80	40 - 130	50 - 130
N	Copper alloys - easy to machine (brass - bronze)		40 - 50	45 - 120	50 - 100	120 - 200	80 - 165
N	Copper alloys - difficult to machine / Aluminium bronze	(CuAlFe) (Ampco)	30 - 40	45 - 90	40 - 95	90 - 180	60 - 140
N	Gold, silver		35 - 45	45 - 120	50 - 100	120 - 200	75 - 170

Ø 0.30 - 0.50		Ø 0.50 - 0.80		Ø 0.80 - 1.60		Ø 1.60 - 3.00		Ø 3.00 - 5.00	
fz	ae ap	fz	ae ap	fz	ae ap	fz	ae ap	fz	ae ap
0.002 - 0.004	< 0.90 x Ø < 2.00 x Ø	0.004 - 0.006	< 0.90 x Ø < 2.00 x Ø	0.006 - 0.011	< 0.90 x Ø < 2.00 x Ø	0.008 - 0.030	< 0.90 x Ø < 2.00 x Ø	0.020 - 0.040	< 0.90 x Ø < 2.00 x Ø
0.002 - 0.003	< 0.90 x Ø < 2.00 x Ø	0.003 - 0.006	< 0.90 x Ø < 2.00 x Ø	0.005 - 0.010	< 0.90 x Ø < 2.00 x Ø	0.008 - 0.028	< 0.90 x Ø < 2.00 x Ø	0.018 - 0.039	< 0.90 x Ø < 2.00 x Ø
0.003 - 0.005	< 0.90 x Ø < 2.00 x Ø	0.004 - 0.007	< 0.90 x Ø < 2.00 x Ø	0.006 - 0.012	< 0.90 x Ø < 2.00 x Ø	0.009 - 0.030	< 0.90 x Ø < 2.00 x Ø	0.020 - 0.043	< 0.90 x Ø < 2.00 x Ø
0.002 - 0.003	< 0.90 x Ø < 2.00 x Ø	0.003 - 0.005	< 0.90 x Ø < 2.00 x Ø	0.004 - 0.009	< 0.90 x Ø < 2.00 x Ø	0.007 - 0.025	< 0.90 x Ø < 2.00 x Ø	0.017 - 0.037	< 0.90 x Ø < 2.00 x Ø
0.002 - 0.003	< 0.90 x Ø < 2.00 x Ø	0.003 - 0.005	< 0.90 x Ø < 2.00 x Ø	0.004 - 0.009	< 0.90 x Ø < 2.00 x Ø	0.007 - 0.025	< 0.90 x Ø < 2.00 x Ø	0.017 - 0.037	< 0.90 x Ø < 2.00 x Ø
0.001 - 0.002	< 0.90 x Ø < 2.00 x Ø	0.003 - 0.004	< 0.90 x Ø < 2.00 x Ø	0.003 - 0.006	< 0.90 x Ø < 2.00 x Ø	0.004 - 0.018	< 0.90 x Ø < 2.00 x Ø	0.010 - 0.028	< 0.90 x Ø < 2.00 x Ø
0.003 - 0.005	< 0.90 x Ø < 2.00 x Ø	0.004 - 0.008	< 0.90 x Ø < 2.00 x Ø	0.007 - 0.013	< 0.90 x Ø < 2.00 x Ø	0.009 - 0.034	< 0.90 x Ø < 2.00 x Ø	0.022 - 0.056	< 0.90 x Ø < 2.00 x Ø
0.003 - 0.005	< 0.90 x Ø < 2.00 x Ø	0.004 - 0.007	< 0.90 x Ø < 2.00 x Ø	0.006 - 0.012	< 0.90 x Ø < 2.00 x Ø	0.008 - 0.030	< 0.90 x Ø < 2.00 x Ø	0.021 - 0.049	< 0.90 x Ø < 2.00 x Ø
0.003 - 0.005	< 0.90 x Ø < 2.00 x Ø	0.004 - 0.008	< 0.90 x Ø < 2.00 x Ø	0.006 - 0.012	< 0.90 x Ø < 2.00 x Ø	0.008 - 0.030	< 0.90 x Ø < 2.00 x Ø	0.021 - 0.049	< 0.90 x Ø < 2.00 x Ø
0.001 - 0.002	< 0.40 x Ø < 2.00 x Ø	0.001 - 0.003	< 0.40 x Ø < 2.00 x Ø	0.002 - 0.004	< 0.50 x Ø < 2.00 x Ø	0.003 - 0.011	< 0.50 x Ø < 2.00 x Ø	0.006 - 0.017	< 0.90 x Ø < 2.00 x Ø
0.004 - 0.005	< 0.90 x Ø < 2.00 x Ø	0.005 - 0.008	< 0.90 x Ø < 2.00 x Ø	0.006 - 0.015	< 0.90 x Ø < 2.00 x Ø	0.013 - 0.030	< 0.90 x Ø < 2.00 x Ø	0.019 - 0.040	< 0.90 x Ø < 2.00 x Ø
0.005 - 0.011	< 0.90 x Ø < 2.00 x Ø	0.009 - 0.018	< 0.90 x Ø < 2.00 x Ø	0.012 - 0.030	< 0.90 x Ø < 2.00 x Ø	0.020 - 0.064	< 0.90 x Ø < 2.00 x Ø	0.030 - 0.075	< 0.90 x Ø < 2.00 x Ø
0.003 - 0.007	< 0.90 x Ø < 2.00 x Ø	0.006 - 0.011	< 0.90 x Ø < 2.00 x Ø	0.008 - 0.019	< 0.90 x Ø < 2.00 x Ø	0.013 - 0.040	< 0.90 x Ø < 2.00 x Ø	0.019 - 0.047	< 0.90 x Ø < 2.00 x Ø
0.003 - 0.007	< 0.90 x Ø < 2.00 x Ø	0.006 - 0.011	< 0.90 x Ø < 2.00 x Ø	0.008 - 0.019	< 0.90 x Ø < 2.00 x Ø	0.013 - 0.040	< 0.90 x Ø < 2.00 x Ø	0.019 - 0.047	< 0.90 x Ø < 2.00 x Ø

CUTTING CONDITIONS - PLUNGING



$$n \text{ [tr/min]} = \frac{Vc \text{ [m/min]} \times 1000}{\pi \times D_1 \text{ [mm]}}$$

$$Vf \text{ [mm/min]} = n \text{ [tr/min]} \times fz \text{ [mm]} \times Z$$

Materials to be machined		Ø 0.30 - 0.80		Ø 0.80 - 1.60		Ø 1.60 - 5.00		
		CARBIDE	C-TOP	CARBIDE	C-TOP	CARBIDE	C-TOP	
		Vc [m/min]	Vc [m/min]	Vc [m/min]	Vc [m/min]	Vc [m/min]	Vc [m/min]	
P	Unalloyed steel / Low alloyed steel	< 600 N/mm ²	25 - 45	40 - 130	120 - 200			
P	Unalloyed steel / Low alloyed steel	600 – 1500 N/mm ²	25 - 45	40 - 120	90 - 160			
P	Lead alloyed cutting steel		30 - 50	45 - 130	110 - 200			
P	High alloyed steel	700 – 1500 N/mm ²	20 - 45	40 - 110	90 - 135			
M	Stainless steel	400 – 700 N/mm ²	25 - 50	45 - 120	100 - 160			
M	DUPLEX stainless steel	> 800 N/mm ²	15 - 35	30 - 90	75 - 130			
K	Grey cast iron / Nodular pearlitic iron	< 250 HB	25 - 45	30 - 90	45 - 125	80 - 180	70 - 165	150 - 200
K	Alloyed cast iron / Nodular pearlitic iron	> 250 HB	20 - 40	30 - 80	40 - 100	70 - 150	60 - 140	130 - 175
K	Nodular ferritic cast iron / Malleable cast iron		20 - 35	30 - 70	35 - 90	60 - 125	55 - 120	110 - 155
S	Special alloys / Heat resistant stainless steel	Inconel Nimonic Hastelloy	20 - 30	30 - 80	60 - 110			
S	Titanium, titanium alloys		20 - 40	30 - 45	30 - 80	40 - 130	50 - 130	120 - 120
N	Copper alloys - easy to machine (brass - bronze)		40 - 50	45 - 120	50 - 100	120 - 200	80 - 165	150 - 210
N	Copper alloys - difficult to machine / Aluminium bronze	(CuAlFe) (Ampco)	30 - 40	45 - 90	40 - 95	90 - 180	60 - 140	130 - 200
N	Gold, silver		35 - 45	45 - 120	50 - 100	120 - 200	75 - 170	160 - 220

Ø 0.30 - 0.50		Ø 0.50 - 0.80		Ø 0.80 - 1.60		Ø 1.60 - 3.00		Ø 3.00 - 5.00	
fz	α	fz	α	fz	α	fz	α	fz	α
0.0010 - 0.0020	30°	0.0016 - 0.0032	30°	0.0026 - 0.0040	30°	0.0043 - 0.0100	30°	0.0090 - 0.0120	30°
0.0010 - 0.0020	35°	0.0016 - 0.0032	35°	0.0028 - 0.0042	35°	0.0045 - 0.0084	35°	0.0075 - 0.0115	35°
0.0006 - 0.0010	35°	0.0016 - 0.0034	35°	0.0028 - 0.0042	35°	0.0047 - 0.0090	35°	0.0084 - 0.0125	35°
0.0004 - 0.0006	30°	0.0010 - 0.0030	30°	0.0024 - 0.0036	30°	0.0037 - 0.0075	30°	0.0070 - 0.0110	30°
0.0004 - 0.0006	30°	0.0006 - 0.0025	30°	0.0020 - 0.0030	30°	0.0028 - 0.0070	30°	0.0065 - 0.0110	30°
0.0002 - 0.0006	15°	0.0006 - 0.0022	15°	0.0020 - 0.0028	15°	0.0025 - 0.0055	15°	0.0045 - 0.0075	15°
0.0006 - 0.0010	30°	0.0008 - 0.0036	30°	0.0028 - 0.0042	30°	0.0047 - 0.0126	30°	0.0105 - 0.0165	30°
0.0006 - 0.0010	30°	0.0008 - 0.0034	30°	0.0028 - 0.0042	30°	0.0045 - 0.0120	30°	0.0090 - 0.0150	30°
0.0006 - 0.0010	30°	0.0008 - 0.0034	30°	0.0028 - 0.0042	30°	0.0045 - 0.0120	30°	0.0090 - 0.0150	30°
0.0002 - 0.0006	8°	0.0004 - 0.0026	8°	0.0020 - 0.0030	8°	0.0032 - 0.0065	8°	0.0050 - 0.0090	8°
0.0008 - 0.0010	15°	0.0010 - 0.0036	15°	0.0024 - 0.0044	15°	0.0032 - 0.0075	15°	0.0070 - 0.0120	15°
0.0010 - 0.0022	35°	0.0018 - 0.0036	35°	0.0030 - 0.0044	35°	0.0050 - 0.0126	35°	0.0105 - 0.0165	35°
0.0006 - 0.0014	35°	0.0012 - 0.0034	35°	0.0028 - 0.0038	35°	0.0045 - 0.0120	35°	0.0090 - 0.0145	35°
0.0006 - 0.0014	35°	0.0012 - 0.0034	35°	0.0028 - 0.0038	35°	0.0045 - 0.0120	35°	0.0090 - 0.0145	35°