Recommended Machining Conditions for Solid Carbide Drills D=0.8-2.9mm

ISO	Material		Condition	Tensile Strength [N/mm²]	Hardness HB	Material No.(1)	Cutting Speed V_c (m/min)	Feed (mm/rev) Vs. Drill Diameter			
								Ø0.8-1.4	Ø1.5-1.9	Ø2-2.4	Ø2.5-2.9
P	non-alloy steel and cast steel, free cutting steel	<0.25% C	annealed	420	125	1	50-100	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
		≥0.25% C	annealed	650	190	2	40-100	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
		<0.55% C	quenched and tempered	850	250	3	40-85	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
		≥0.55% C	annealed	750	220	4	40-85	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
			quenched and tempered	1000	300	5	40-85	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
	low alloy and cast steel (less than 5% of alloying elements)		annealed	600	200	6	40-75	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
			quenched and tempered	930	275	7	40-60	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
				1000	300	8	40-60	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
				1200	350	9	40-60	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
	high alloyed steel, cast steel and tool steel		annealed	680	200	10	30-50	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
			quenched and tempered	1100	325	11	30-50	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
	stainless steel and cast steel		ferritic / martensitic	680	200	12	20-35	0.03-0.06	0.04-0.08	0.05-0.10	0.06-0.10
			martensitic	820	240	13	20-35	0.03-0.06	0.04-0.08	0.05-0.10	0.06-0.10
M	stainless steel and cast steel		austenitic, duplex	600	180	14	20-35	0.03-0.06	0.04-0.08	0.05-0.10	0.06-0.10
K	gray cast iron (GG)		ferritic / pearlitic		180	15	40-80	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
			pearlitic / martensitic		260	16	40-70	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
	nodular cast iron (GGG)		ferritic		160	17	40-95	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
			pearlitic		250	18	50-95	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
	malleable cast iron		ferritic		130	19	40-80	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
			pearlitic		230	20	40-80	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
N	aluminum-wrought alloys		not hardenable		60	21	80-150	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
			hardenable		100	22	80-150	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
	aluminum-cast alloys	≤12% Si	not hardenable		75	23	80-150	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
			hardenable		90	24	80-150	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
		>12% Si	high temperature		130	25	80-150	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
	copper alloys	>1% Pb	free cutting		110	26	80-150	0.03-0.10	0.05-0.15	0.07-0.17	0.08-0.20
			brass		90	27	50-150	0.05-0.12	0.07-0.15	0.08-0.18	0.09-0.18
			electrolytic copper		100	28	60-160	0.05-0.15	0.07-0.18	0.08-0.20	0.09-0.22
	non metallic		duroplastics, fiber plastics			29					
			hard rubber			30					
S	high temperature alloys	Fe based	annealed		200	31	10-20	0.02-0.04	0.03-0.06	0.04-0.07	0.04-0.08
			hardened		280	32	10-20	0.02-0.04	0.03-0.06	0.04-0.07	0.04-0.08
		Ni or Co based	annealed		250	33	10-20	0.02-0.04	0.03-0.06	0.04-0.07	0.04-0.08
			hardened		350	34	10-20	0.02-0.04	0.03-0.06	0.04-0.07	0.04-0.08
			cast		320	35	10-20	0.02-0.04	0.03-0.06	0.04-0.07	0.04-0.08
	titanium alloys		pure	RM 400		36	10-20	0.02-0.03	0.02-0.03	0.03-0.04	0.03-0.04
			alpha+beta alloys, hardened	RM 1050		37	10-20	0.02-0.03	0.02-0.03	0.03-0.04	0.03-0.04
H	hardened steel		hardened		55 HRC	38	10-20	0.01-0.02	0.01-0.02	0.02-0.03	0.02-0.03
			hardened		60 HRC	39	10-20	0.01-0.02	0.01-0.02	0.02-0.03	0.02-0.03
	chilled cast iron		cast		400	40	10-20	0.01-0.02	0.01-0.02	0.02-0.03	0.02-0.03
	cast iron		hardened		55 HRC	41	10-20	0.01-0.02	0.01-0.02	0.02-0.03	0.02-0.03

- For drill with lengh to diameter ratio larger than 6xD, reduce feed by 20%
- If the RPM exceeds 10,000, a dynamic balance should be done to the system
- Maximal radial and axial runout should not exceed 0.01mm
- As a starting value, the middle of the recommended machining range should be used, then (according to wear results), conditions can be changed in order to optimize performance.

(1) For workpiece materials list, see pages 542-637

Recommended Machining Conditions for Solid Carbide Drills D=3.0-20.0mm

ISO	Material		Condition	Tensile Strength [N/mm²]	Hardness HB	Material No.(1)	Cutting Speed V_c m/min	Feed (mm/rev) Vs. Drill Diameter				
								Ø3-5	Ø5.1-8	Ø8.1-12	Ø12.1-16	Ø16.1-20
P	non-alloy steel and cast steel, free cutting steel	<0.25% C	annealed	420	125	1	80-120	0.10-0.18	0.15-0.25	0.2-0.30	0.20-0.35	0.25-0.40
		≥0.25% C	annealed	650	190	2	80-110	0.10-0.18	0.15-0.25	0.2-0.30	0.20-0.35	0.25-0.40
		<0.55% C	quenched and tempered	850	250	3	70-100	0.10-0.20	0.15-0.28	0.2-0.35	0.20-0.38	0.25-0.42
		≥0.55% C	annealed	750	220	4						
			quenched and tempered	1000	300	5						
	low alloy and cast steel (less than 5% of alloying elements)		annealed	600	200	6	70-90	0.10-0.18	0.15-0.25	0.2-0.30	0.20-0.35	0.25-0.40
			quenched and tempered	930	275	7						
				1000	300	8	60-80	0.10-0.18	0.15-0.25	0.2-0.30	0.20-0.35	0.25-0.40
				1200	350	9	50-70	0.10-0.20	0.15-0.28	0.2-0.35	0.20-0.38	0.25-0.42
	high alloyed steel, cast steel and tool steel		annealed	680	200	10	60-80	0.10-0.20	0.15-0.28	0.18-0.35	0.20-0.38	0.25-0.42
			quenched and tempered	1100	325	11	50-70	0.10-0.15	0.12-0.20	0.14-0.25	0.16-0.30	0.18-0.32
	stainless steel and cast steel		ferritic / martensitic	680	200	12	25-75	0.04-0.10	0.05-0.15	0.05-0.18	0.08-0.20	0.10-0.20
			martensitic	820	240	13	25-75	0.04-0.10	0.05-0.15	0.05-0.18	0.08-0.20	0.10-0.20
M	stainless steel and cast steel		austenitic, duplex	600	180	14	25-75	0.04-0.10	0.05-0.15	0.05-0.18	0.08-0.20	0.10-0.20
K	gray cast iron (GG)		ferritic / pearlitic		180	15	85-105	0.15-0.25	0.20-0.35	0.25-0.45	0.30-0.50	0.35-0.55
			pearlitic / martensitic		260	16	75-90	0.15-0.25	0.20-0.35	0.25-0.45	0.30-0.50	0.35-0.55
	nodular cast iron (GGG)		ferritic		160	17	65-80	0.12-0.20	0.15-0.25	0.20-0.35	0.25-0.40	0.30-0.45
			pearlitic		250	18						
	malleable cast iron		ferritic		130	19						
			pearlitic		230	20						
N	aluminum-wrought alloys		not hardenable		60	21	70-300	0.10-0.25	0.15-0.35	0.25-0.45	0.30-0.50	0.35-0.55
			hardenable		100	22	70-200					
	aluminum-cast alloys	≤12% Si	not hardenable		75	23	70-300	0.07-0.18	0.12-0.25	0.20-0.35	0.25-0.45	0.30-0.50
			hardenable		90	24						
		>12% Si	high temperature		130	25						
	copper alloys	>1% Pb	free cutting		110	26						
			brass		90	27						
			electrolytic copper		100	28						
	non metallic		duroplastics, fiber plastics			29						
			hard rubber			30						
S	high temperature alloys	Fe based	annealed		200	31						
			hardened		280	32						
		Ni or Co based	annealed		250	33						
			hardened		350	34						
			cast		320	35						
	titanium alloys		pure	RM 400		36						
			alpha+beta alloys, hardened	RM 1050		37	15-35	0.02-0.07	0.04-0.10	0.06-0.12	0.08-0.15	0.08-0.18
H	hardened steel		hardened		55 HRC	38	40-70	0.06-0.10	0.08-0.12	0.10-0.14	0.12-0.16	0.14-0.18
			hardened		60 HRC	39						
	chilled cast iron		cast		400	40						
	cast iron		hardened		55 HRC	41						

As a starting value, the middle of the recommended machining range should be used, then (according to wear results), conditions can be changed in order to optimize performance.

- When using external coolant supply only, reduce cutting speed by 10%
- Use internal coolant supply when machining austenitic stainless steel

(1) For workpiece materials list, see pages 542-637