



EB 80 single-fluted gun drills

Article no. **5812**



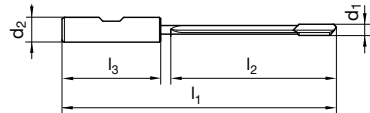
Cutting data page 79



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P	M	K	N	S	H
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Deep hole drills



Article no.

5812

d1 mm	inch	d2 h6 mm	l1 mm	l2 mm	l3 mm	Order no.
3.969	5/32	10.0	200.0	155.0	40.0	5812 3.970
4.000		12.0	200.0	155.0	45.0	5812 4.000
4.200		12.0	210.0	165.0	45.0	5812 4.200
4.366	11/64	12.0	215.0	165.0	45.0	5812 4.370
4.500		12.0	220.0	175.0	45.0	5812 4.500
4.763	3/16	12.0	230.0	180.0	45.0	5812 4.760
5.000		16.0	230.0	182.0	48.0	5812 5.000
5.159	13/64	16.0	230.0	197.0	48.0	5812 5.160
5.500		16.0	245.0	197.0	48.0	5812 5.500
5.556	7/32	16.0	260.0	207.0	48.0	5812 5.560
5.953	15/64	16.0	260.0	212.0	48.0	5812 5.950
6.000		16.0	260.0	212.0	48.0	5812 6.000
6.350	1/4	16.0	275.0	227.0	48.0	5812 6.350
6.500		16.0	275.0	227.0	48.0	5812 6.500
6.747	17/64	16.0	290.0	242.0	48.0	5812 6.750
7.000		16.0	290.0	242.0	48.0	5812 7.000
7.144	9/32	16.0	315.0	262.0	48.0	5812 7.140
7.500		16.0	320.0	270.0	48.0	5812 7.500
7.541	19/64	16.0	320.0	272.0	48.0	5812 7.540
7.938	5/16	16.0	320.0	272.0	48.0	5812 7.940
8.000		16.0	320.0	272.0	48.0	5812 8.000
8.334	21/64	16.0	355.0	302.0	48.0	5812 8.330
8.500		16.0	360.0	305.0	48.0	5812 8.500
8.731	11/32	16.0	370.0	317.0	48.0	5812 8.730
9.000		16.0	350.0	302.0	48.0	5812 9.000
9.128	23/64	16.0	395.0	327.0	48.0	5812 9.130
9.500		16.0	395.0	340.0	48.0	5812 9.500
9.525	3/8	16.0	380.0	330.0	48.0	5812 9.530
9.922	25/64	16.0	400.0	350.0	48.0	5812 9.920
10.000		20.0	400.0	350.0	50.0	5812 10.000
10.319	13/32	20.0	425.0	370.0	50.0	5812 10.320
10.500		20.0	435.0	380.0	50.0	5812 10.500
10.716	27/64	20.0	430.0	380.0	50.0	5812 10.720
11.000		20.0	430.0	380.0	50.0	5812 11.000
11.113	7/16	20.0	430.0	380.0	50.0	5812 11.110
11.500		20.0	470.0	415.0	50.0	5812 11.500
11.906	15/32	20.0	450.0	400.0	50.0	5812 11.910
12.000		20.0	450.0	400.0	50.0	5812 12.000
12.303	31/64	20.0	495.0	440.0	50.0	5812 12.300
12.500		20.0	505.0	450.0	50.0	5812 12.500
12.700	1/2	20.0	500.0	450.0	50.0	5812 12.700
13.000		20.0	520.0	465.0	50.0	5812 13.000
13.097	33/64	20.0	520.0	465.0	50.0	5812 13.100
13.500		20.0	530.0	475.0	50.0	5812 13.500
13.891	35/64	20.0	535.0	480.0	50.0	5812 13.890
14.000		20.0	540.0	485.0	50.0	5812 14.000
14.288	9/16	25.0	555.0	494.0	56.0	5812 14.290
14.500		25.0	565.0	500.0	56.0	5812 14.500

Article no.

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d1 mm	inch	d2 h6 mm	l1 mm	l2 mm	l3 mm	Order no.
14.684	37/64	25.0	570.0	509.0	56.0	5812 14.680
15.000		25.0	580.0	520.0	56.0	5812 15.000
15.081	19/32	25.0	580.0	520.0	56.0	5812 15.080
15.478	39/64	25.0	595.0	534.0	56.0	5812 15.480
15.500		25.0	600.0	535.0	56.0	5812 15.500
15.875	5/8	25.0	610.0	549.0	56.0	5812 15.880
16.000		25.0	615.0	555.0	56.0	5812 16.000
16.272	41/64	25.0	620.0	559.0	56.0	5812 16.270
16.500		25.0	630.0	569.0	56.0	5812 16.500
16.669	21/32	25.0	635.0	574.0	56.0	5812 16.670
17.000		25.0	645.0	584.0	56.0	5812 17.000
17.066	43/64	25.0	645.0	584.0	56.0	5812 17.070
17.463	11/16	25.0	660.0	599.0	56.0	5812 17.460
17.859	45/64	25.0	675.0	614.0	56.0	5812 17.860
18.000		25.0	680.0	619.0	56.0	5812 18.000
18.256	23/32	25.0	685.0	624.0	56.0	5812 18.260
18.653	47/64	25.0	700.0	639.0	56.0	5812 18.650
19.000		25.0	710.0	649.0	56.0	5812 19.000
19.050	3/4	32.0	715.0	650.0	60.0	5812 19.050
19.447	49/64	32.0	730.0	665.0	60.0	5812 19.450
19.844	25/32	32.0	745.0	680.0	60.0	5812 19.840
20.000		32.0	750.0	685.0	60.0	5812 20.000
20.241	51/64	32.0	750.0	685.0	60.0	5812 20.240
20.638	13/16	32.0	760.0	695.0	60.0	5812 20.640
21.000		32.0	770.0	705.0	60.0	5812 21.000
21.034	53/64	32.0	770.0	705.0	60.0	5812 21.030
21.431	27/32	32.0	785.0	720.0	60.0	5812 21.430
21.828	55/64	32.0	795.0	730.0	60.0	5812 21.830
22.000		32.0	800.0	735.0	60.0	5812 22.000
22.225		32.0	810.0	745.0	60.0	5812 22.230
22.622	57/64	32.0	820.0	755.0	60.0	5812 22.620
23.000		32.0	835.0	770.0	60.0	5812 23.000
23.019	29/32	32.0	835.0	770.0	60.0	5812 23.020
23.416	59/64	32.0	850.0	785.0	60.0	5812 23.420
23.813	15/16	32.0	860.0	798.0	60.0	5812 23.810
24.000		32.0	865.0	800.0	60.0	5812 24.000
24.209	61/64	32.0	875.0	810.0	60.0	5812 24.210
24.606	31/32	32.0	885.0	820.0	60.0	5812 24.610
25.000	63/64	32.0	900.0	835.0	60.0	5812 25.000
25.400	1	32.0	910.0	845.0	60.0	5812 25.400



Single-fluted gun drills EB 80, EB 80 XXL



Cutting data

Machining group			f (mm/rev) with nom. Ø								
	v _c (m/min)		4	8	10	12	14	16	20	25	32
P1.1.1 Unalloyed steel, annealed, 0.15 % C, Rm 420 N/mm ² , 125 HB	80	85	0.020	0.040	0.045	0.050	0.060	0.065	0.080	0.095	0.110
P1.1.2 Unalloyed steel, heat-treated, 0.15 % C, Rm 420 N/mm ² , 125 HB	70	75	0.020	0.035	0.040	0.045	0.055	0.060	0.070	0.085	0.100
P1.1.3 Unalloyed steel, annealed, 0.45 % C, Rm 640 N/mm ² , 190 HB	70	75	0.020	0.035	0.040	0.045	0.055	0.060	0.070	0.085	0.100
P1.1.4 Unalloyed steel, heat-treated, 0.45 % C, Rm 640 N/mm ² , 190 HB	70	70	0.020	0.030	0.040	0.045	0.050	0.055	0.065	0.080	0.095
P1.1.5 Unalloyed steel, heat-treated, 0.45 % C, Rm 850 N/mm ² , 250 HB	70	70	0.020	0.030	0.040	0.045	0.050	0.055	0.065	0.080	0.095
P1.1.6 Unalloyed steel, annealed, 0.75 % C, Rm 915 N/mm ² , 270 HB	65	65	0.015	0.030	0.035	0.040	0.045	0.050	0.065	0.075	0.090
P1.1.7 Unalloyed steel, heat-treated, 0.75 % C, Rm 1020 N/mm ² , 300 HB	60	65	0.015	0.030	0.035	0.040	0.045	0.050	0.060	0.070	0.085
P2.1.1 Low-alloy steel, annealed, Rm 610 N/mm ² , 180 HB	70	75	0.020	0.035	0.040	0.045	0.050	0.060	0.070	0.085	0.100
P2.1.2 Low-alloy steel, heat-treated, Rm 930 N/mm ² , 275 HB	70	75	0.020	0.035	0.040	0.045	0.050	0.060	0.070	0.085	0.100
P2.1.3 Low-alloy steel, heat-treated, Rm 1020 N/mm ² , 300 HB	60	60	0.015	0.030	0.035	0.040	0.045	0.050	0.060	0.070	0.085
P2.1.4 Low-alloy steel, heat-treated, Rm 1190 N/mm ² , 350 HB	55	55	0.015	0.025	0.030	0.035	0.040	0.045	0.050	0.060	0.075
P3.1.1 High-alloy steel and tool steel, annealed, Rm 680 N/mm ² , 200 HB	60	65	0.020	0.035	0.040	0.045	0.050	0.060	0.070	0.085	0.100
P3.1.2 High-alloy steel and tool steel, hardened and tempered, Rm 1100 N/mm ² , 325 HB	50	55	0.015	0.030	0.035	0.040	0.045	0.050	0.060	0.070	0.085
M1.1.1 Stainless steel, ferritic/martensitic, with machining additives	50	55	0.015	0.025	0.030	0.035	0.040	0.045	0.050	0.060	0.075
M1.1.2 Stainless steel, ferritic/martensitic, annealed, Rm 680 N/mm ² , 200 HB	45	45	0.015	0.025	0.025	0.030	0.035	0.040	0.045	0.055	0.065
M1.1.3 Stainless steel, ferritic/martensitic, heat-treated, Rm 810 N/mm ² , 240 HB	45	45	0.012	0.020	0.025	0.030	0.035	0.035	0.045	0.055	0.060
M2.1.1 Stainless steel, austenitic, quenched, 180 HB	40	40	0.012	0.020	0.025	0.030	0.035	0.035	0.045	0.050	0.060
M2.2.1 Duplex steel, high-strength stainless steels	35	35	0.010	0.020	0.020	0.025	0.030	0.030	0.035	0.045	0.050
K1.1.1 Grey cast iron, pearlitic/ferritic, 180 HB	80	85	0.030	0.050	0.060	0.070	0.080	0.085	0.105	0.125	0.145
K1.1.2 Grey cast iron, pearlitic/martensitic, 260 HB	70	70	0.025	0.045	0.050	0.060	0.065	0.075	0.090	0.105	0.125
K1.2.1 Cast iron with spheroidal graphite, ferritic, 160 HB	70	70	0.025	0.045	0.050	0.060	0.065	0.075	0.090	0.105	0.125
K1.2.2 Cast iron with spheroidal graphite, pearlitic, 250 HB	65	65	0.025	0.040	0.050	0.055	0.065	0.070	0.085	0.100	0.115
K1.3.1 Malleable cast iron, ferritic, 130 HB	65	65	0.025	0.040	0.050	0.055	0.065	0.070	0.085	0.100	0.115
K1.3.2 Malleable cast iron, pearlitic, 230 HB	55	60	0.020	0.035	0.040	0.050	0.055	0.060	0.075	0.085	0.105
K2.1.1 Vermicular graphite cast iron (GJV)	65	70	0.025	0.040	0.050	0.060	0.065	0.075	0.085	0.105	0.120
K2.2.1 Austenitic-ferritic spheroidal graphite cast iron (ADI)	50	50	0.020	0.030	0.040	0.045	0.050	0.055	0.065	0.080	0.090
N1.1.1 Wrought aluminium alloys, non-hardened, 60 HB	80	85	0.035	0.060	0.070	0.080	0.090	0.100	0.120	0.145	0.170
N1.1.2 Wrought aluminium alloys, hardened, 100 HB	80	85	0.035	0.060	0.070	0.080	0.090	0.100	0.120	0.145	0.170
N2.1.1 Aluminium casting alloys, non-hardened, ≤ 12 % Si, 75 HB	120	125	0.095	0.165	0.200	0.230	0.260	0.290	0.350	0.415	0.490
N2.1.2 Aluminium casting alloys, hardened, ≤ 12 % Si, 90 HB	120	125	0.095	0.165	0.200	0.230	0.260	0.290	0.350	0.415	0.490
N2.1.3 Aluminium casting alloys, non-hardened, > 12 % Si, 130 HB	100	105	0.080	0.140	0.170	0.195	0.225	0.250	0.295	0.355	0.415
N3.1.1 Copper and copper alloys: Free-machining alloy, Pb > 1 %	70	75	0.040	0.065	0.080	0.095	0.105	0.115	0.140	0.165	0.195
N3.1.2 Copper and copper alloys: CuZn, CuSnZn	60	60	0.035	0.055	0.070	0.080	0.090	0.100	0.120	0.140	0.165
N3.1.3 Copper and copper alloys: CuSn, lead-free copper and copper electrolyte	55	60	0.030	0.055	0.065	0.075	0.085	0.095	0.110	0.135	0.155
N4.1.1 Non-metallic materials: Duroplastics, fibre-reinforced plastics	60	65	0.025	0.040	0.050	0.060	0.065	0.075	0.085	0.105	0.120
N4.1.2 Non-metallic materials: Hard rubber, wood, etc.	60	65	0.025	0.040	0.050	0.060	0.065	0.075	0.085	0.105	0.120
N4.1.3 Non-metallic materials: Graphite	60	65	0.025	0.040	0.050	0.060	0.065	0.075	0.085	0.105	0.120
S1.1.1 Heat-resistant alloys, Fe-based, annealed, 200 HB	40	40	0.010	0.015	0.020	0.025	0.025	0.030	0.035	0.040	0.050
S1.1.2 Heat-resistant alloys, Fe-based, hardened, 280 HB	30	35	0.008	0.015	0.015	0.020	0.020	0.025	0.030	0.035	0.040
S1.1.3 Heat-resistant alloys, Ni- or Co-based, annealed, 250 HB	25	25	0.007	0.015	0.015	0.015	0.020	0.020	0.025	0.030	0.035
S1.1.4 Heat-resistant alloys, Ni- or Co-based, hardened, 350 HB	20	25	0.007	0.012	0.015	0.015	0.020	0.020	0.025	0.030	0.035
S1.1.5 Heat-resistant alloys, Ni- or Co-based, cast, 320 HB	20	20	0.006	0.011	0.015	0.015	0.015	0.020	0.025	0.025	0.030
S2.1.1 Titanium alloys, pure titanium, Rm 400 N/mm ²	30	30	0.007	0.015	0.015	0.015	0.020	0.020	0.025	0.030	0.035
S2.1.2 Titanium alloys, Alpha and Beta alloys, hardened, Rm 1050 N/mm ²	25	30	0.006	0.011	0.015	0.015	0.020	0.020	0.025	0.030	0.035
H1.1.1 Hardened steel, hardened and tempered, < 55 HRC	30	30	0.007	0.015	0.015	0.015	0.020	0.020	0.025	0.030	0.035
H1.1.2 Hardened steel, hardened and tempered, < 60 HRC	20	20	0.006	0.010	0.012	0.015	0.015	0.015	0.020	0.025	0.030
H1.1.3 Hardened steel, hardened and tempered, > 60 HRC	20	20	0.005	0.009	0.011	0.015	0.015	0.015	0.020	0.025	0.030
H2.1.1 Chilled cast iron, 400 HB	20	20	0.007	0.015	0.015	0.015	0.020	0.020	0.025	0.030	0.035
H2.1.2 Chilled cast iron, hardened and tempered, < 55 HRC	15	15	0.005	0.009	0.011	0.012	0.015	0.015	0.020	0.020	0.025

The drilling process

A brief introduction to the subject of deep hole drilling

In the machining world, drilling depths of $10 \times D$ and deeper are regarded as deep hole drilling operations, whereby smaller drilling depths can naturally also be produced with gun drills. Advantage is taken of the positive side effects, as for example good surface quality, low deviation from concentricity and optimised alignment accuracy.

High pressure cooling - has become a matter of course.

In recent years, internal cooling has established itself for all drilling tools. Coolants are now living up to their name and being supplied via coolant ducts to where they are urgently required. Considerable improvements in tool life and less breakages have been achieved by this measure for twist drills, taps etc.

Every conventional machine tool currently on the market can be supplied with high pressure internal cooling and is therefore also suitable for deep hole drilling.

The share of gun drills on machining centres, lathes etc. is forever gaining more importance. The process is therefore increasing in popularity in the machining world.



All gun drills must have support for the pilot hole.

Gun drills must never operate at full speed without support in the machine shop.

Deep hole drilling is not a closed book, but can be mastered by anybody as long as certain conditions are adhered to.

Recommended cutting rates for the application of Guhring gun drills can be found on the pages for the individual types!

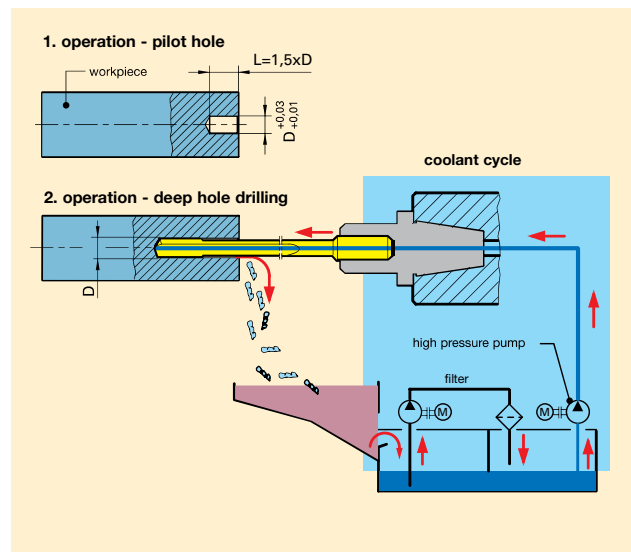
Typical procedure with all gun drills on conventional machine tools:

- production of pilot hole ($L = 3 \times D$, tolerance H8)
- enter at low revolutions, approx. 200 rev./min, feed rate approx. 500 mm/min. With tools for drilling depths in excess than $40 \times D$ enter the pilot hole revolving in left hand direction.
- At cutting speeds higher than 120 m/min we recommend to advance to final speed in several steps.
- setting of coolant pressure and revolutions
- uninterrupted drilling to required drilling depth without wood pecking. When applying gun drills with increased length-diameter-ratio, we recommend machining with reduced cutting parameters (approx. 75% of the optimal cutting speed) up to a drilling depth of approx. 25 mm.
- switching off coolant supply after reaching the required hole depth
- withdrawal in top gear with stationary spindle

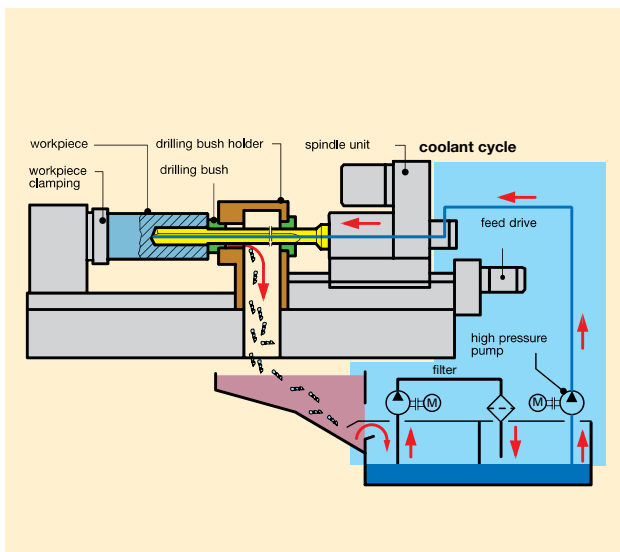
Application advice

- For drilling depths in excess than $40 \times D$ we recommend the use of two or more gun drills, e. g. $\varnothing 10 \times 400$ mm and $\varnothing 9.95 \times 800$ mm.
- Gun drills for drilling depths of more than $40 \times D$ should enter the pilot hole revolving in the left hand direction.
- When changing tools for drilling depths of more than $40 \times D$, the tool can be damped by switching on coolant supply for just one second.
- For machining of long-chipping materials we recommend the use of gun drills with polished flutes.
- Generally we recommend the use of soluble oil with a minimum oil content of 10 %.
- Single-fluted gun drills for long-chipping aluminium should be supplied with point grind 180° and coolant chamber.

Deep hole drilling on conventional machine tools



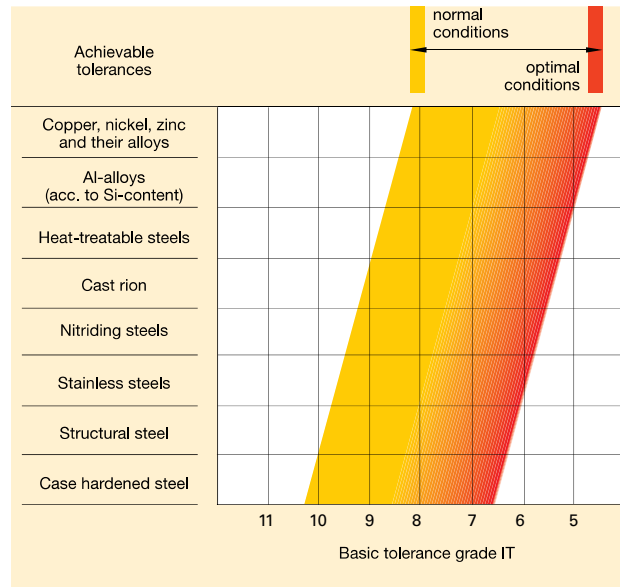
Deep hole drilling machines



Precision of single-fluted gun drills

Basic tolerances*

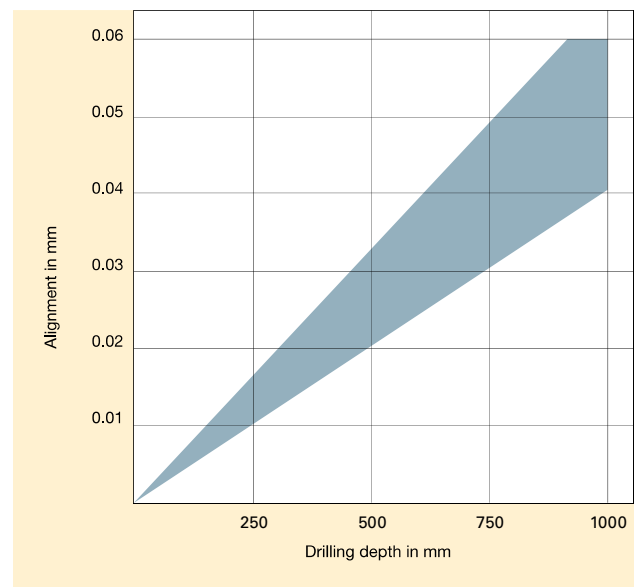
The application of single-fluted gun drills can achieve a lower basic tolerance, as the cutting forces at the cutting edge are absorbed by the guide pads, unlike twist drills where the slightest deviation of the two cutting edges causes a larger hole.



Alignment accuracy*

Because brazed single-fluted gun drills always have the precision carbide head brazed on to a flexible tube, the tool achieves very accurate aligned holes remaining unaffected by possible concentricity errors.

However, extreme material fluctuations and other influencing factors can impair the alignment accuracy.

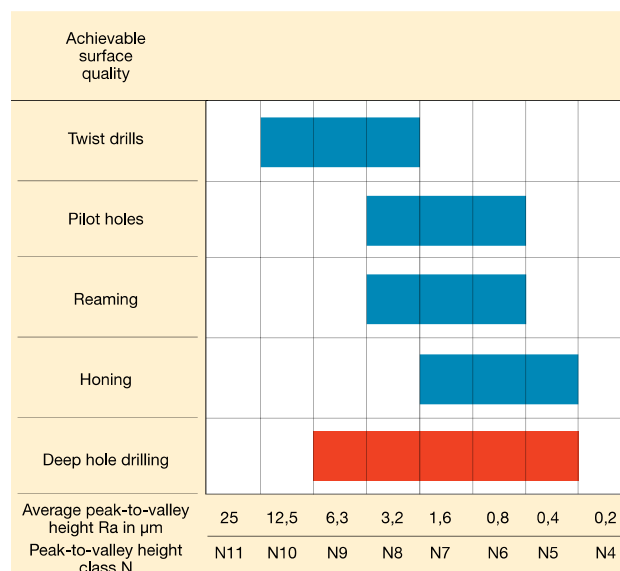


Surface quality*

The forces at the cutting edge are absorbed by the support bushes, which in return burnishes the surface.

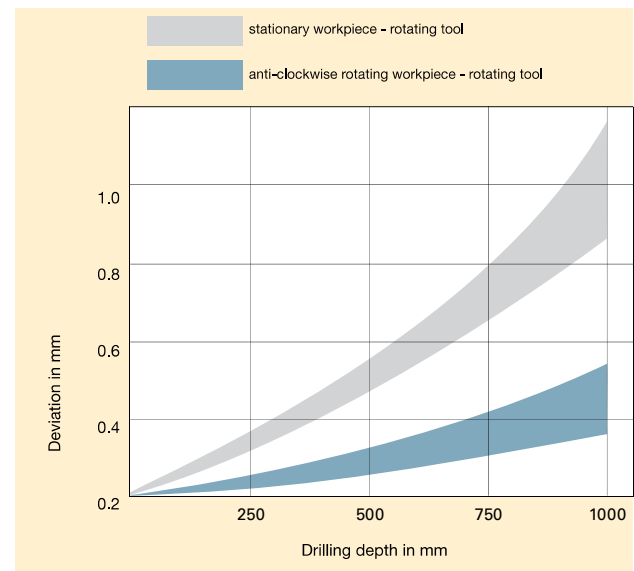
Lubrication between the guide pads and hole surface is therefore very important.

The better the lubricant, the better the surface quality.



Deviation from concentricity*

When a hole is produced with, for example, a commercial twist drill, the quality of the point grind affects the concentricity of the hole. An imbalance of forces is created at the cutting edges. With gun drills, these cutting forces are absorbed by the guide pads, resulting in excellent concentricity.



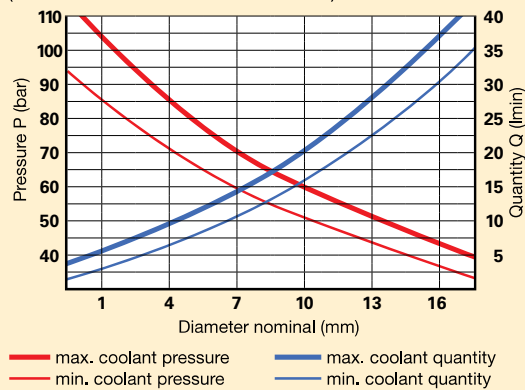
* gun drills with two cutting edges – straight-fluted as well as spiral-fluted – achieve approx. 50% of the values stated

Please note:

- All gun drills must be applied with internal cooling, either air, water or oil. Without internal cooling the chips cannot be evacuated.
- All gun drills can be applied with oil as the medium for internal cooling. However, in this case a 30% higher pressure is required in order to achieve the same coolant volume.
- When MQL is applied with gun drills an increase in pressure may be necessary for smaller nominal diameters dependent on the pressure of the MQL system.
- If the cooling lubricant data is insufficient the cutting parameters may be reduced. Pressure boosting systems are also possible.

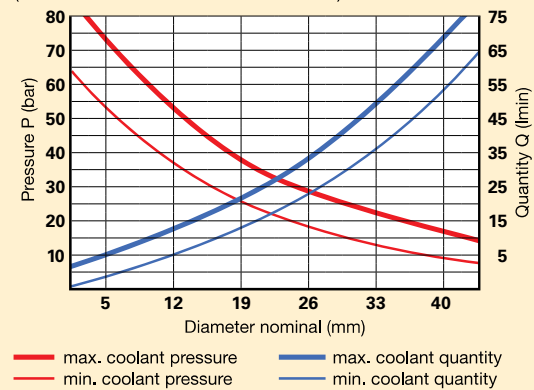
Coolant values EB 100

(recommended values for soluble oil)



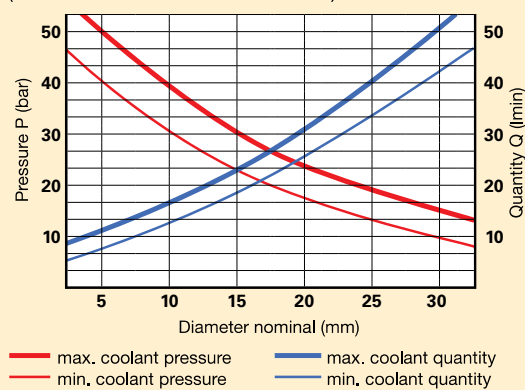
Coolant values EB 80

(recommended values for soluble oil)



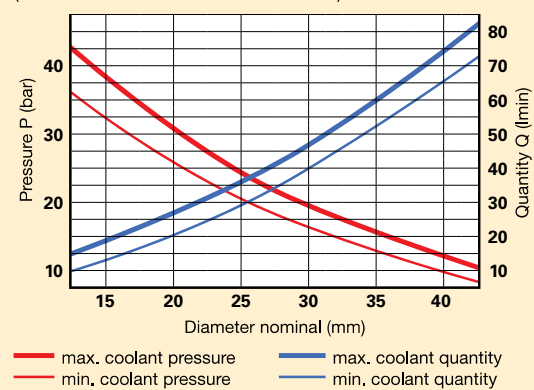
Coolant values ZB 80

(recommended values for soluble oil)



Coolant values EB 800

(recommended values for soluble oil)



Gun drills

Drill Ø mm from	Feed column no.									
	11	12	13	14	15	16	17	18	19	20
	f (mm/rev.)									
1.50	0.002	0.004	0.006	0.008	0.012	0.020	0.032	0.045	0.045	0.075
2.00	0.003	0.005	0.007	0.010	0.016	0.028	0.046	0.055	0.050	0.100
2.50	0.004	0.006	0.008	0.012	0.018	0.030	0.054	0.070	0.075	0.125
4.00	0.005	0.007	0.010	0.016	0.025	0.043	0.065	0.085	0.120	0.240
6.00	0.007	0.009	0.013	0.024	0.035	0.061	0.085	0.120	0.180	0.360
8.00	0.010	0.014	0.022	0.032	0.045	0.068	0.100	0.150	0.240	0.480
10.00	0.012	0.016	0.028	0.040	0.055	0.075	0.120	0.160	0.300	0.600
14.00	0.020	0.025	0.035	0.050	0.065	0.085	0.130	0.180	0.420	0.700
18.00	0.025	0.030	0.040	0.055	0.070	0.095	0.145	0.200		
20.00	0.026	0.035	0.045	0.060	0.080	0.110	0.180	0.250		
24.00	0.027	0.036	0.047	0.065	0.085	0.130	0.185	0.300		
28.00	0.028	0.038	0.049	0.068	0.090	0.140	0.195	0.350		
30.00	0.030	0.040	0.050	0.070	0.100	0.150	0.200	0.400		
35.00	0.035	0.045	0.055	0.075	0.120	0.180	0.250	0.450		
40.00	0.040	0.050	0.060	0.080	0.150	0.200	0.300	0.500		

*The feed rates always relate to tools with the recommended coating. In some cases the successful application of un-coated tools cannot be guaranteed.



All deep hole drills must have support for the pilot hole.
Deep hole drills must never operate at full speed without support in the machine shop.

The sequence of operations for deep hole drilling

- production of pilot hole (L ≈ 3 x D, tolerance H8)
- enter at low revolutions, approx. 200 rev./min, feed rate approx. 500 mm/min. With tools for drilling depths in excess than 40 x D enter the pilot hole revolving in left hand direction.
- at cutting speeds higher than 120 m/min we recommend to advance to final speed in several steps.
- setting of coolant pressure and revolutions
- uninterrupted drilling to required drilling depth without wood pecking. When applying gun drills with increased length-diameter-ratio, we recommend machining with reduced cutting parameters (approx. 75% of the optimal cutting speed) up to a drilling depth of approx. 25 mm.
- switching off coolant supply after reaching the required hole depth
- withdrawal in top gear with stationary spindle
- for EB100 gun drills > 50xD please note: up to drilling depth 50xD the feed has to be reduced to 60%

EB100

single-fluted gun drill

solid carbide

0.9 ... 12.0



Material dependent coolants

- air ○
neat oil ●
soluble oil ●

Material group	Material examples Figures in bold = material no. to DIN EN	Tens.str. Hardness N/mm ²	Cool- ant	rec. coating*	≤50xD		>50xD	
					V _c m/min	Feed col. no.	V _c m/min	Feed col. no.
Common structural steels	1.0035 S185, 1.0486 P275N, 1.0345 P235GH, 1.0425 1.0050 E295, 1.0070 E360, 1.8937 P500NH	≤500 ≤1000	○ ●		100 85	15 15	100 85	15 15
Free-cutting steels	1.0718 11SMnPb30, 1.0736 11SMn37	≤850 ≤1000	○ ●		90 80	15 15	90 80	15 15
Unalloyed heat-treatable steels	1.0727 46S20, 1.0728 60S20, 1.0757 46SPb20	≤700 ≤850 ≤1000	○ ● ●		80 80 75	14 14 14	80 80 75	14 14 14
Alloyed heat-treatable steels	1.0402 C22, 1.1178 C30E 1.0503 C45, 1.1191 C45E 1.0601 C60, 1.1221 C60E	≤700 ≤850 ≤1000	○ ● ●		75 75 75	14 14 14	75 75 75	14 14 14
Alloyed case hard. steels	1.5131 50MnSi4, 1.7003 38Cr2, 1.7030 28Cr4	≤1000 ≤1400	○ ●		65 80	14 15	65 80	14 15
Alloyed case hardened steels	1.5710 36NiCr6, 1.7035 41Cr4, 1.7225 42CrMo4	≤850 ≤1000 ≤1400	○ ● ●		75 65 75	14 14 14	75 65 75	14 14 14
Unalloyed case hard. steels	1.0301, 1.1121 C10E	≤850	○		75	14	75	14
Nitriding steels	1.7276 10CrMo11, 1.5125 11MnSi6 1.5752 15NiCr13, 1.7131 16MnCr5, 1.7264 20CrMo5	≤1000 ≤1400 ≤1000 ≤1400	○ ● ● ●		65 65 65 65	14 14 14 14	65 65 65 65	14 14 14 14
Tool steels	1.8504 34CrAl6 1.8519 31CrMoV9, 1.8550 34CrAlNi7	≤850 ≤1400	○ ●		75 65	13 13	75 65	13 13
High speed steels	1.2080 X210Cr12, 1.2083 X42Cr13, 1.2419 , 1.2767	≤1400	●		55	12	55	12
Spring steels	1.3243 S 6-5-2-5, 1.3343 S 6-5-2, 1.3344 S 6-5-3	≤1400	●		65	13	65	13
Stainless steels, sulphured	1.5026 55Si7, 1.7176 55Cr3, 1.8159 51CrV4	≤350 HB	●		40	14	40	14
Stainless steels, austenitic	1.4005 X12CrS13, 1.4104 X14CrMoS17, 1.4105	≤900	●		35	14	35	14
Stainless steels, martensitic	1.4301 X5CrNi18-10, 1.4541 X6CrNiTi18-10, 1.4571 1.4057 X20CrNi172, 1.4122 X39CrMo17-1, 1.4521	≤1100 ≤1500	● ●		35 30 25 20	14 13 10 12	35 30 25 20	14 13 10 12
Hardened steels	-	≤48 HRC ≤66 HRC	● ●		85 80 80 70 70 55	16 16 15 15 14 14	85 80 80 70 70 55	16 16 15 15 14 14
Special alloys	Nimonic, Inconel, Monel, Hastelloy	≤2000	●		35 30 150	12 12 17	35 30 150	12 12 17
Cast iron	0.6010 EN-GJL-100, 0.6020 EN-GJL-200 0.6025 EN-GJL-250, 0.6035 EN-GJL-350	≤240 HB ≤350 HB	○ ○		120 120 130	19 20 18	120 120 130	19 20 18
Spheroidal graphite iron and malleable cast iron	0.7050 EN-GJS-500-7, 0.8035 EN-GJMW-350-4 0.7070 EN-GJS-700-2, 0.8170 EN-GJMB-700-2	≤240 HB ≤350 HB	○ ○		110 75 120 90 95 75	17 15 18 18 17 17	110 75 120 90 95 75	17 15 18 18 17 17
Chilled cast iron	-	≤350 HB	○		60 70 60 75 70	15 15 17 15 15	60 70 60 75 70	15 15 17 15 15
Ti and Ti-alloys	3.7024 Ti99.5, 3.7114 TiAl5Sn2.5, 3.7124 TiCu2 3.7154 TiAl6Zr5, 3.7165 TiAl6V4, 3.7184	≤850 ≤1400	○ ●		120 120 130 110 75 120 90 95 75	19 20 18 17 15 18 18 17 15	120 120 130 110 75 120 90 95 75	19 20 18 17 15 18 18 17 15
Aluminium and Al-alloys	3.0255 Al99.5, 3.2315 AlMgSi1, 3.3515 AlMg1	≤400	○		60 70 60 75 70	15 15 17 15 15	60 70 60 75 70	15 15 17 15 15
Al wrought alloys	3.0615 AlMgSiPb, 3.1325 AlCuMg1, 3.3245 , 3.4365	≤650	○		120 120 130 110 75 120 90 95 75	19 20 18 17 15 18 18 17 15	120 120 130 110 75 120 90 95 75	19 20 18 17 15 18 18 17 15
Al cast alloys ≤ 10 % Si	3.2131 G-AlSi5Cu1, 3.2153 G-AlSi7Cu3, 3.2573 G-AlSi9	≤600	○		60 70 60 75 70	15 15 17 15 15	60 70 60 75 70	15 15 17 15 15
Al cast alloys ≤ 24 % Si	3.2581 G-AlSi12, 3.2583 G-AlSi12Cu, - G-AlSi12CuNiMg	≤600	○		120 120 130 110 75 120 90 95 75	19 20 18 17 15 18 18 17 15	120 120 130 110 75 120 90 95 75	19 20 18 17 15 18 18 17 15
Magnesium alloys	3.5200 MgMn2, 3.5812.05 G-MgAl8Zn1, 3.5612.05	≤400	○		60 70 60 75 70	15 15 17 15 15	60 70 60 75 70	15 15 17 15 15
Copper, low-alloyed	2.0070 SE-Cu, 2.1020 CuSn6, 2.1096 G-CuSn5ZnPb	≤500	○		120 90 95 75 70	18 18 17 17 17	120 90 95 75 70	18 18 17 17 17
Brass, short-chipping	2.0380 CuZn39Pb2, 2.0401 CuZn39Pb3, 2.0410	≤600	○		60 70 60 75 70	15 15 17 15 15	60 70 60 75 70	15 15 17 15 15
Brass, long-chipping	2.0250 CuZn20, 2.0280 CuZn33, 2.0332 CuZn37Pb0.5	≤600	○		120 90 95 75 70	18 18 17 17 17	120 90 95 75 70	18 18 17 17 17
Bronze, short-chipping	2.1090 CuSn7ZnPb, 2.1170 CuPb5Sn5, 2.1176	≤600 ≤850	○ ●		60 70 60 75 70	15 15 17 15 15	60 70 60 75 70	15 15 17 15 15
Bronze, long-chipping	2.0916 CuAl5, 2.0960 CuAl9Mn, 2.1050 CuSn10 2.0980 CuAl11Ni, 2.1247 CuBe2	≤850 ≤1000	○ ●		120 90 95 75 70	18 18 17 17 17	120 90 95 75 70	18 18 17 17 17
Duroplastics	Bakelint, Resopal, Pertinax, Moltopren	≤150	○		60 70 60 75 70	15 15 17 15 15	60 70 60 75 70	15 15 17 15 15
Thermoplastics	Plexiglas, Hostalen, Novodur, Makralon	≤100	○		120 90 95 75 70	18 18 17 17 17	120 90 95 75 70	18 18 17 17 17
New cast materials GGV	EN-GJV250 (GGV25), EN-GJV350 (GGV35) EN-GJV400 (GGV40), EN-GJV500 (GGV50), SiMo 6	≤220 HB ≤300 HB	○ ○		60 70 60 75 70	14 14 17 15 15	60 70 60 75 70	14 14 17 15 15
New cast materials ADI	EN-GJS-800-8 (ADI800), EN-GJS-1000-5 (ADI1000) EN-GJS-1200-2 (ADI1200), EN-GJS-1400-1 (ADI1400)	≤1000 ≤1400	○ ○		60 70 60 75 70	14 14 17 15 15	60 70 60 75 70	14 14 17 15 15
Kevlar	Kevlar	≤1000	○		60 50	14 14	60 50	14 14
Glass, carbon concentr, plastics	GFK/CFK	≤1000	○					

Ⓐ TiAlN SuperA

Ⓒ TiCN

Ⓕ FIRE

Ⓗ TiN

