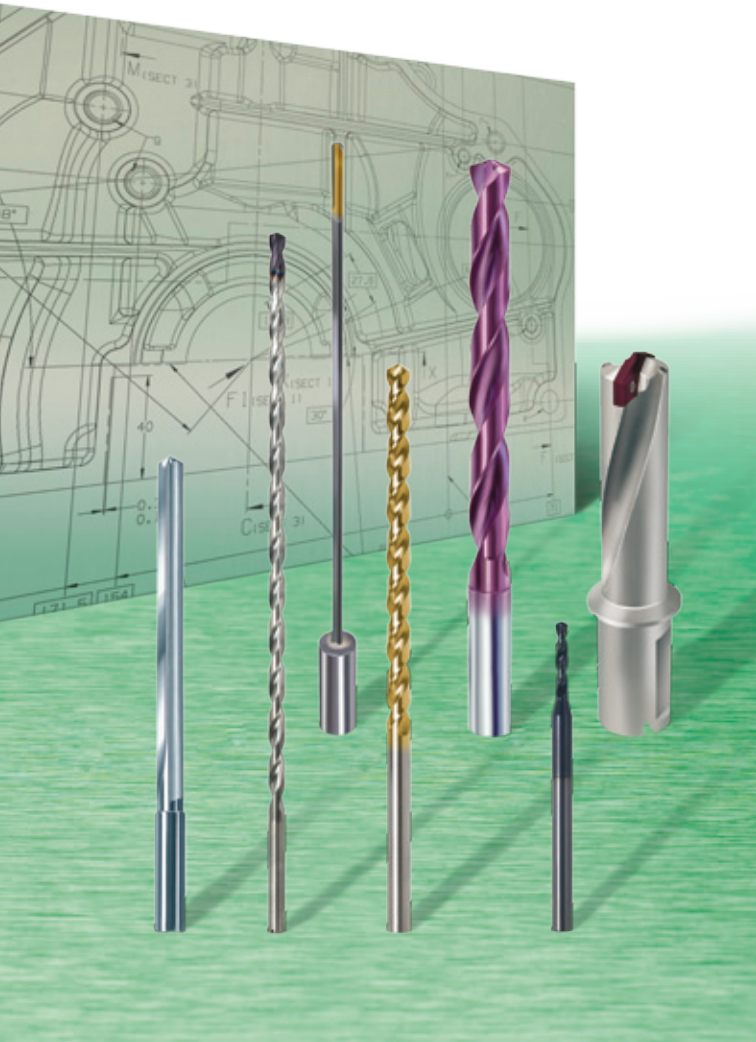
HARTNER

Precision Cutting Tools

Technical manual

Edition 2012



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Application recommendations for carbide drills type TS 100 7xD, 10xD and 12xD

Pilot holes are necessary for extra length tools ≥ 7xD

The pilot hole can be produced with a short, rigid drill. The diameter should be 0.01 – 0.02 mm larger than the diameter of the extra length tool, the drill depth ≥ 1xD.

Alternatively the drill can produce their own pilot hole. Cutting speed and feed rate should be reduced by 30 – 40%.

The recommended **minimum coolant pressure** is 40 bar.

For safety reasons it is very important, that a drill does not exceed a speed of n=6000 rev./min. when unsupported. The centrifugal forces can break these long tools before reaching the workpiece.

Procedure for spiraled deep hole drills TS 100 T

- Initial milling of surface. The surface must be machined at right angles to the entry angle of the drilling operation.
- Production of a cylindrical pilot hole (tolerance F9) with a minimum drilling depth of 1 x D.
- Entry in the pilot hole at a speed of approx. 300 rev./min and with a feed rate of approx. 500 mm/min.
- Setting of coolant pressure and speed.
- Continuous drilling to complete hole depth without wood pecking.
- For through holes with straight exit (90°), reduce the feed rate vf to 50% approx. 1 mm prior to break-through.
- For through holes with oblique exit, reduce the feed rate vf to 40% approx. 1 mm prior to break-through.
- After reaching hole depth stop machine spindle and coolant supply, withdrawal in top gear.

More detailed information about the drills in our application recommendations you will find in the up-to-date issues of our catalogue and brochures, we will send to you on request.

Application recommendations

Tools with **bold** feed column no. are prefered choice.

○ bright
◍ steam tempered
◓ nitrided lands

Ⓣ TiN
ⓐ AlTiN nanoA
Ⓐ TiAlN

Ⓐ AlTiN
Ⓒ TiCN
Ⓕ FIRE

Ⓨ TiAlSiN

Drill-Ø mm	Feed column no. 1	2	3	4	5	6	7	8	9
	f (mm/rev.)								
0.50	0.004	0.006	0.007	0.008	0.010	0.012	0.014	0.016	0.019
1.00	0.006	0.008	0.012	0.014	0.016	0.018	0.020	0.023	0.025
2.00	0.020	0.025	0.032	0.040	0.050	0.063	0.080	0.100	0.125
2.50	0.025	0.032	0.040	0.050	0.063	0.080	0.100	0.125	0.160
3.15	0.032	0.040	0.050	0.063	0.080	0.100	0.125	0.160	0.160
4.00	0.040	0.050	0.063	0.080	0.100	0.125	0.160	0.200	0.200
5.00	0.040	0.050	0.063	0.080	0.100	0.125	0.160	0.200	0.250
6.30	0.050	0.063	0.080	0.100	0.125	0.160	0.200	0.250	0.315
8.00	0.063	0.080	0.100	0.125	0.160	0.200	0.250	0.315	0.315
10.00	0.080	0.100	0.125	0.160	0.200	0.250	0.315	0.400	0.400
12.50	0.080	0.100	0.125	0.160	0.200	0.250	0.315	0.400	0.500
16.00	0.100	0.125	0.160	0.200	0.250	0.315	0.400	0.500	0.630
20.00	0.125	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.630
25.00	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.800	0.800
31.50	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.800	1.000
40.00	0.200	0.250	0.315	0.400	0.500	0.630	0.800	1.000	1.250
50.00	0.250	0.310	0.400	0.500	0.630	0.800	1.000	1.250	1.250
63.00	0.315	0.400	0.500	0.630	0.800	1.000	1.250	1.600	1.600
80.00	0.400	0.500	0.630	0.800	1.000	1.250	1.600	1.600	2.000

Material group	Material examples Figures in bold = material no. to DIN EN
Common structural steels	**1.0035** S185(St33),**1.0486** P275N(StE285),**1.03** **1.0050** E295 (St50-2), **1.0070** E360 (St70-2),
Free-cutting steels	**1.0718** 11SMnPb30 (9SMnPb28), **1.0736** 11 **1.0727** 46S20 (45S20), **1.0728** (60S20), **1.07**
Unalloyed heat-treatable steels	**1.0402** C22, **1.1178** C30E (Ck30) **1.0503** C45, **1.1191** C45E (Ck45) **1.0601** C60, **1.1221** C60E (Ck60)
Alloyed heat-treatable steels	**1.5131** 50MnSi4, **1.7003** 38Cr2, **1.7030** 28C **1.5710** 36NiCr6, **1.7035** 41Cr4, **1.7225** 42Cr
Unalloyed case hardened steels	**1.0301** (C10), **1.1121** C10E (Ck10)
Alloyed case hardened steels	**1.7276** 10CrMo11, **1.5125** 11MnSi6 **1.5752** 15NiCr13, **1.7131** 16MnCr5, **1.7264**
Nitriding steels	**1.8504** 34CrAl6 **1.8519** 31CrMoV9, **1.8550** 34CrAlNi7
Tools steels	**1.1750** C75W, **1.2067** 102Cr6, **1.2307** 29CrM **1.2080** X210Cr12, **1.2083** X42Cr13, **1.2419** 1
High speed steels	**1.3243** S 6-5-2-5, **1.3343** S 6-5-2, **1.3344** S
Spring steels	**1.5026** 55Si7, **1.7176** 55Cr3, **1.8159** 51CrV4
Stainless steels, sulphured austenitc martensitic	**1.4005** X12CrS13, **1.4104** X14CrMoS17, **1.4** **1.4301** X5CrNi18-10 (V2A), **1.4541** X6CrNiTi **1.4057** X20CrNi 17 2 (X17CrNi16-2), **1.4122** X
Hardened steels	–
Special alloys	Nimonic, Inconel, Monel, Hastelloy
Cast iron	**0.6010** EN-GJL-100(GG10), **0.6020** EN-GJL- **0.6025** EN-GJL-250(GG25), **0.6035** EN-GJL-
Spheroidal graphite and malleable cast iron	**0.7050** EN-GJS-500-7(GGG50), **0.8035** EN- **0.7070** EN-GJS-700-2(GGG70), **0.8170** EN-
Chilled cast iron	–
Ti and Ti-alloys	**3.7024** Ti99,5, **3.7114** TiAl5Sn2,5, **3.7124** Ti **3.7154** TiAl6Zr5, **3.7165** TiAl6V4, **3.7184** TiA
Al and Al-alloys	**3.0255** Al99,5, **3.2315** AlMgSi1, **3.3515** AlMg
Al-wrought alloys	**3.0615** AlMgSiPb, **3.1325** AlCuMg1, **3.3245**
Al cast iron ≤ 10 % Si > 10 % Si	**3.2131** G-AlSi5Cu1, **3.2153** G-AlSi7Cu3, **3.2** **3.2581** G-AlSi12, **3.2583** G-AlSi12Cu, - G-A
Magnesium alloys	**3.5200** MgMn2, **3.5812.05** G-MgAl8Zn1, **3.5**
Copper, low-alloyed	**2.0070** SE-Cu, **2.1020** CuSn6, **2.1096** G-Cu
Brass, short-chipping long-chipping	**2.0380** CuZn39Pb2, **2.0401** CuZn39Pb3, **2.0** **2.0250** CuZn20, **2.0280** CuZn33, **2.0332** Cu
Bronzes, short-chipping	**2.1090** CuSn7ZnPb, **2.1170** CuPb5Sn5, **2.1** **2.0790** CuNi18Zn19Pb
Bronzes, long-chipping	**2.0916** CuAl5, **2.0960** CuAl9Mn, **2.1050** CuS **2.0980** CuAl11Ni, **2.1247** CuBe2
Duroplastics Thermoplastics	Epoxy resin, Resopal, Pertinax, Moltopren Plexiglass, Hostalen, Novodur, Makralon
New cast materials GGV	**EN-GJV250 (GGV25)**, **EN-GJV350** (GGV35) **EN-GJV400** (GGV40), **EN-GJV500** (GGV50),
New cast materials ADI	**EN-GJS-800-8** (ADI800), **EN-GJS-1000-5** (A **EN-GJS-1200-2** (ADI1200), **EN-GJS-1400-1**
Kevlar Glass, carbon concentr. plastics	Kevlar GFK/CFK

* Use bright finish drills or use drills with bright polished flutes
** Cutting lip corrected to appr. 10°

R right-hand cutting
L left-hand cutting

Coolant
Soluble oil
Neat oil
Luft

To compare the new and old material abbreviations see page 66!

	Ten. strength MPa (N/mm²)	Hardness	Coolant
45 P235GH(H1),**1.0425** P265GH(H2)	≤500		○
1.8937 P500NH (WStE500)	≤1000		○
SMn37 (9SMn36)	≤850		○
57 46SPb20 (45SPb20)	≤1000		○
	≤700		○
	≤850		○
	≤1000		○
r4	≤1000		○
rMo4	≤1400		○
	≤850		○
	≤1000		●
20CrMo5	≤1400		●
	≤1000		○
	≤1400		●
MoV9	≤850		○
05WCr6, **1.2767** X45NiCrMo4	≤1400		●
6-5-3	≤1400		●
(51CrV4)		≤350 HB	●
105 X6CrMoS17, **1.4305** X8CrNiS18-9	≤900		●
18-10, **1.4571** X6CrNiMoTi 17-12-2 (V4A)	≤1100		●
39CrMo17-1, **1.4521** X2CrMoTi18-2	≤1500		●
		≤48 HRC	●
		≤66 HRC	●
	≤2000		●
-200(GG20)		≤240 HB	○○
-350(GG35)		≤350 HB	○○
GJMW-350-4(GTW35)		≤240 HB	○
GJMB-700-2(GTS70)		≤350 HB	○
		≤350 HB	○
Cu2	≤850		●
l4Mo4Sn2,5, - TiAl8Mo1V1	≤1400		●
g1	≤400		○
AlMg3Si, **3.4365** AlZnMgCu1,5	≤650		○
2573 G-AlSi9	≤600		○
lSi12CuNiMg	≤600		○
5612.05 G-MgAl6Zn1	≤400		○
Sn5ZnPb	≤500		○
0410 CuZn43Pb2	≤600		○
Zn37Pb0,5	≤600		○
176 CuPb10Sn	≤600		○●
	≤850		●
Sn10	≤850		●
	≤1000		●
	≤150		○
	≤100		○○
		≤220 HB	○○
SiMo 6		≤300 HB	○○
ADI1000)	≤1000		○○
(ADI1400)	≤1400		○○
	≤1000		○
	≤1000		○

≤3×D drilling depth

Order no. R	81110	81120	81130	81140	84400	84501
Order no. L	81115			81145		
Standard	1897	1897	1897	1897	1897	1897
Tool material	HSS				HSS	HSS
Surface	○ ⌀2.36	○	○	○ ⌀2.36	T	F
Type	N	H	W	FN	N	N






v_c m/min	Feed col. no.				v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
27	**6**			6	30	**6**	32	**7**
22	**5**			5	24	**5**	26	**6**
30	6			**6**	33	**6**	36	**7**
30	5			5	33	5	36	6
25	**5**			**5**	28	**5**	31	**6**
25	**5**			**5**	28	**5**	31	**6**
					25	4	28	5
					22	4	24	5
30	**6**			6	33	6	36	**7**
					20	4	22	5
					14	4	16	5
16	4			4	18	4	20	5
30	**6**			6	33	**6**	36	7
30	6			6	33	6	36	**7**
25	**6**			6	28	**6**	31	7
20	6			6	22	6	24	**7**
70			**7**	7			85	**8**
70			**7**	7			85	**8**
50	7*		7	**7**			60	**8**
50	6*			**6**			60	**7**
70	6*	**6**		6	80	**6**	90	**6**
60	5*		5	**5**	65	**5**	70	**6**
70		**6**			75	**5**	80	**6**
40	5*		5	**5**	45	**5**	50	**6**
30	4*	4		**4**	33	**4**	36	**5**
25	4*			4	27	4	30	5
15	4*			4	16	**4**	18	**5**
					15	4	18	5
18	4	4		**4**	22	**4**	29	**5**
28	5*	**5**	5	5	36	**5**	47	6

81171	82971	81173	82972	84803	84503	84805	84806
1897	Hartner	1897	Hartner	1897	1897	6537	1897
HSS-E				HSS-E	HSS-E	HSS-E	HSS-E
				T	F	T	T
V	V	IS	IS	V	V	FU 500	FU500DZ





v_c m/min	Feed col. no.				v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
35	5	5	5	5	38	5	42	6	38	**6**	45	**6**
30	5	5	5	5	33	4	36	5	33	**5**	35	**5**
40	5	5	5	5	44	5	48	6	44	**6**	50	**6**
40	**5**	**5**	5	5	38	5	42	6	40	**6**	40	**6**
40	5	5	5	5	44	5	48	6	44	**6**	42	**6**
40	5	5			44	5	48	6	44	**6**	35	**6**
35	**4**	**4**			38	**4**	42	**5**	40	**5**	22	**5**
20	**4**	**4**			27	**4**	30	**5**	27	4	18	4
16	**3**	**3**			22	**3**	24	**4**	22	3	15	3
36	6	6	6	6	44	4	48	5	44	**6**	40	**6**
20	**4**	**4**			22	**4**	24	**5**	22	4	20	4
15	**3**	**3**			18	**3**	20	**4**	18	3	15	3
16	4	**4**			22	4	24	**5**	22	4	18	4
12	3	**3**			18	3	20	**4**	16	3	12	3
15	**4**	**4**			19	**4**	21	**5**	20	4	18	4
12	**3**	**3**			14	**3**	16	**4**	15	3	13	3
15	3	**3**			14	3	17	**4**	13	3	13	3
8	**2**	**2**			9	**2**	11	**3**	9	2		
18	4	4	**4**	**4**	20	4	22	5	20	**4**	18	**4**
14	3	3	**3**	**3**	15	3	17	**4**	16	**3**	12	**4**
16	3	**3**	3	3	18	3	20	**4**	18	**4**	15	**4**
4	1	1			4	1	5	2				
8	1	1			6	2	7	2				
35	**6**	6			40	6	45	7	45	**6**	45	**6**
30	**6**	**6**			35	**6**	40	**7**	40	**6**	36	**6**
30	6	6			33	6	36	7	40	**6**	40	**6**
25	**6**	**6**			27	6	29	7	30	**6**	28	**6**
10	3	3			12	3	14	4				
10	2	2	2	2	11	2	12	3				
6	2	2	2	2	7	2	8	3				
90			7	7							70	**7**
90			7	7							70	**7**
80			7	7							85	**7**
70			6	6							70	**6**
70			6	6					80	6	70	6
40			5	5					88	**5**	32	**5**
60			5	5					77	**5**	63	**5**
40			5	5					44	**5**	40	**5**
35	4	4	4	4	45	5	50	6	45	**4**	50	**4**
30	**4**	**4**	4	4	40	**4**	45	**5**	40	**4**	35	**4**
20	4	4	**4**	**4**	23	4	26	5	30	**4**	32	**4**
15	4	4	**4**	**4**	17	4	20	**5**	25	**4**	28	**4**
20	4	4							22	**4**	25	**4**
30			4	4					27	**4**	15	**4**

≤3×D drilling depth

Order no. R	84511	89235	89246	89301	89309	89302	89303
Order no. L							
Standard	1897	6539	Hartner	8037	Hartner	8041	8038
Tool material	HSS-E-PM	Carbide					
Surface	●	○	○	○	○	○	◓
Type	FN 500	N	N	N	N	N	N







v_c m/min	Feed col. no.	v_c m/min	Feed col. no.				
42	6	*80*	4				
37	5	*70*	4				
47	**7**	*80*	**5**	4	4	4	
44	6	*70*	**4**	3	3	3	
47	6	*80*	4				
47	6	*70*	4				
44	**5**	*60*	4				
30	4	*60*	4				
25	**3**						
47	4	*80*	5				
25	**5**	*60*	4				
20	**4**						
25	**5**	*50*	4				
18	**4**						
22	**5**	*50*	3				
17	**4**						
14	**4**						
10	**2**	*25*	2	**2**	**2**	**2**	
22	4	*25*	**4**				
18	3	*25*	3				
20	3	*25*	3				
		20	3	3	3	3	
		10		2	2	2	
6	2	*15*	2				
50	**7**	*90*	**4**	4	4	4	
44	**7**	*80*	**4**	4	4	4	
44	**7**	*80*	**4**	4	4	4	
33	**7**	*70*	**4**	4	4	4	
16	4	*10*		**1**	**1**	**1**	
		20	3				
		15	2				
		200	**7**				
		200	**7**				
		150	**6**				
		120	**6**				
		180	**6**				
		80	**5**				
		180	**5**	5	5	5	
		180	**5**	5	5	5	
50	5	*120*	**5**				
44	5	*120*	**5**				
33	5	*70*	4				
28	5	*50*	3				
		50	4	**4**			
		40	3	**3**			3
		80	3	**3**			2

≤5×D drilling depth

81010 81015	81017	81586	81587	81588	82010	81020 81025	81030 81035	82030	81040 81045
338	338	Hartner	Hartner	Hartner	345	338	338	345	338
HSS									
●	●	●	●	●	●	○	○	○	◓
N	N	N	N	N	N	H	W	W	FN

v_c m/min	Feed col. no.									
27	**6**	**6**	**6**	**6**	**6**	**6**	**5**			6
22	**5**	**5**	**5**	**5**	**5**	**5**				5
30	**6**	**6**	**6**	**6**	**6**	**6**				**6**
30	5	5	5	5	5	5				5
25	**5**	**5**	**5**	**5**	**5**	**5**				5
25	**5**	**5**	**5**	**5**	**5**	**5**				5
30	6	6	6	6	6	6				6
16	4	4	4	4	4	4				4
30	**6**	**6**	**6**	**6**	**6**	**6**				6
30	6	6	6	6	6	6				6
25	6	6	6	6	6	6				6
25	6	6	6	6	6	6				6
70	7	7	7	7	7	7		7	7	**7**
70	6	6	6	6	6	6				**6**
50	6	6	6	6	6	6	6			6
50	5	5	5	5	5	5		**5**	**5**	**5**
70							**6**			
40	5	5	5	5	5	5				**5**
30	4	4	4	4	4	4	4			
25	4	4	4	4	4	4				
15	4	4	4	4	4	4				4
18	4	4	4	4	4	4	4			**4**
28	5	5	5	5	5	5	**5**	5	5	

≤5×D drilling depth

Order no. R	84405	84460	84415	84502	81011	82011	81041	81061
Order no. L								
Standard	338	345	338	338	338	345	338	338
Tool material	HSS			HSS	HSS-E			
Surface	T	T	T	F				
Type	N	N	FN	FN	N	N	FN	S

v_c m/min	Feed col. no.		
30	**6**	**6**	6
24	**5**	**5**	5
33	**6**	**6**	**6**
33	5	5	5
28	**5**	**5**	5
28	**5**	**5**	5
25	4	4	4
22	4	4	4
33	**6**	**6**	6
20	4	4	4
14	4	4	4
18	4	4	4
33	6	6	6
33	6	6	6
28	**6**	**6**	6
22	6	6	6
80	6	6	
65	5	5	**5**
75	5	5	5
45	5	5	**5**
33	**4**	**4**	
27	**4**	**4**	
16	**4**	**4**	4
15	**4**	**4**	4
22	4	4	**4**
36	5	5	

v_c m/min	Feed col. no.
32	7
26	6
36	**7**
36	6
31	6
31	6
28	5
24	5
36	7
22	5
16	5
20	5
36	7
36	7
31	7
24	7
85	8
85	8
60	8
60	7
90	7
70	6
80	6
50	6
18	5
18	5
29	5

v_c m/min	Feed col. no.			
35	5	5	5	
30	5	5	5	
40	5	5	5	
40	5	5	**5**	
40	5	5	5	
40	5	5	5	
35	**4**	**4**	4	
20	**4**	**4**	**4**	
16	3	3	**3**	3
36	6	6	6	6
20	**4**	**4**	4	
15	3	3	**3**	3
16	**4**	**4**	4	
12	3	3	**3**	3
15	**4**	**4**	4	
12	**3**	3	**3**	3
15	3	3	**3**	3
8	**2**	2		**2**
18	4	4	**4**	4
14	3	3		**3**
16	3	3	3	**3**
4				
8				1
35	6	6	6	
30	**6**	**6**	6	
30	6	6	6	
28	**6**	**6**	6	
10	3	3	3	3
10				**2**
6				**2**
90				
90				
80			7	
70			6	
70				
40	**5**	5	5	
60				
40	5	5	4	
35	**4**	4		
33	**4**	4		
20	4	4	4	
15	4	4	**4**	
20	4	4	4	

81013	82012	81012		84800	84807		84504	84505		84715	
338	345	338		338	338		338	338		338	
HSS-E		M42		HSS-E			HSS-E			HSS-E	
○	○	○		T	T		F	F		C	
IS	IS	N		FN	S		FN	S		FN	




Feed col. no.			v_c m/min	Feed col. no.		v_c m/min	Feed col. no.		v_c m/min	Feed col. no.
5	5	5	*38*	6		*42*	6		*42*	6
5	5	5	*33*	5		*36*	5		*36*	6
5	5	5	*44*	5		*48*	6		*48*	6
5	5	5	*38*	**5**		*42*	**6**		*42*	**6**
5	5	5								
		5	*44*	5		*48*	6			
		5	*38*	4		*42*	5		*42*	**5**
		4	*27*	4		*30*	**5**		*30*	**5**
		3	*22*	**3**	3	*34*	**4**	4	*34*	**4**
6	6	6	*44*	4		*48*	6		*48*	**7**
		3	*22*	4		*24*	5		*24*	**5**
		3	*18*	**3**		*20*	**4**		*20*	**4**
		3	*22*	4		*24*	5		*20*	**5**
		3	*18*	**3**		*20*	**4**		*15*	**4**
		3	*19*	**4**		*21*	5		*21*	**5**
		3	*14*	**3**		*16*	**4**		*16*	**4**
		3	*14*	**3**	3	*17*	**4**	4	*17*	**4**
		2	*9*		**2**	*11*	3	**2**	*11*	**3**
4	**4**	3	*20*	**4**	4	*22*	**5**	5	*22*	**5**
3	3		*15*		**3**	*17*	4	**3**		
3	3	3	*18*	3	**3**	*20*	4	**4**	*18*	4
		1				*6*	1			
		1	*6*		2	*7*		2		
		5	*40*	6		*45*	7			
		5	*35*	6		*40*	7			
		5	*33*	6		*36*	7			
		5	*27*	6		*29*	7			
		3	*12*		**3**	*14*	4	**3**		
2	2	2	*11*		**2**	*12*		**2**		
2	2	2	*7*		**2**	*8*		**2**		
7	**7**	7								
7	**7**	7								
7	7	7				*85*	8			
6	6	6				*72*	7			
6	6	6								
5	5	5	*88*	5		*96*	6			
5	5	5								
5	5	5								
4	4	4								
4	4	4								
4	**4**	4	*22*	4		*25*	5			
1	**1**	4	*17*	**4**	4	*20*	**5**	4		
			22	4		*24*	5			

≤5×D drilling depth

Order no. R	84804	84802	84801	84615	81062
Order no. L					
Standard	338	338	Hartner	338	338
Tool material	HSS-E	HSS-E	HSS-E	HSS-E	HSS-E
Surface	○	T	T	A	●
Type	FU 500 DZ	FU 500 DZ	FU 500	FN	P2000
Cooling	without	without	without	without	without





v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feedcol. no.	v_c m/min	Feedcol. no.	v_c m/min	Feedcol. no.
35	6	45	6	38	6			35	6
30	5	35	5	33	5			30	5
40	6	50	6	44	6			40	6
30	6	40	6	40	5	42	5	40	5
32	6	42	6	44	6			40	5
28	6	35	6	44	6			40	5
20	5	22	5	40	5			35	4
15	4	18	4	27	4			25	4
13	3	15	3	22	3			20	3
30	6	40	6	44	6			40	6
16	4	20	4	22	4			20	4
12	3	15	3	18	3			15	3
15	4	18	4	22	4			20	4
10	3	12	3	16	3			15	3
15	4	18	4	20	4			18	4
10	3	13	3	15	3			12	3
10	3	13	3	13	3			12	3
				9	2			8	2
14	4	18	4	20	4			14	4
10	4	12	4	16	4			10	3
12	4	15	4	18	4			12	3
								5	2
36	6	45	6	45	6	45	7	38	6
30	6	36	6	40	6	40	7	30	6
30	6	40	6	40	6	36	7	30	6
22	6	28	6	30	6	29	7	25	6
								10	3
50	7	70	7					90	7
50	7	70	7					90	7
65	7	85	7					80	7
60	6	70	6					70	6
60	6	70	6	80	6	85	7	85	6
25	5	32	5	88	5	96	6	80	5
45	5	63	5	77	5			70	5
30	5	40	5	44	5			40	5
36	4	50	4	45	4			40	4
30	4	35	4	40	4			30	4
30	4	32	4	30	4	25	5	25	4
25	4	28	4	25	4	20	5	15	4
20	4	25	4	22	4	24	5	20	4
15	4	15	4	27	4			25	5

84811	84507	82761	84461	89244
338	Hartner	Hartner	Hartner	Hartner
HSS-E-PM	HSS-E-PM	HSS-E	HSS-E	Solid carb.
T	F	○	T	○
FN 500 DZ	FN 500	FN	FN	N
without	without	with	with	without





v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
40	6	42	6	48	7	60	7	80	4
32	5	37	5	38	6	48	6	70	4
45	6	47	6	48	7	60	7	80	**5**
40	5	44	6	38	6	48	6	70	**4**
42	6	47	6	48	6	60	6	80	4
40	5	47	6	48	6	60	6	70	4
28	**4**	44	**5**	45	**5**	50	**5**	60	4
25	4	30	4	30	**5**	33	**5**	60	4
20	**3**	25	**3**	28	**4**	31	**4**		
40	4	47	3	50	7	55	7	80	5
22	**4**	25	**4**	25	**5**	31	**5**	60	4
18	**3**	20	**3**	25	**4**	31	**4**		
20	**4**	25	**4**	25	**5**	30	**5**	50	4
15	**3**	18	**4**	20	**4**	24	**4**		
25	**4**	22	**5**	24	5	30	5	50	3
15	**3**	17	**4**	17	**4**	20	**4**		
15	**3**	14	**4**	14	**4**	18	**4**		
12	**2**	10	**2**	12	**3**	15	**3**	25	2
15	4	22	4	20	**5**	25	**5**	25	**4**
10	3	18	3	14	**4**	18	**4**	25	3
12	3	20	3	16	**4**	20	**4**	25	3
				4	**3**	5	**3**	20	3
		6	2	10	**2**	12	**2**	15	2
50	**6**	50	**7**	48	7	60	7	90	**4**
40	**6**	44	**7**	38	**7**	48	**7**	80	**4**
45	**6**	44	**7**	42	7	52	7	70	**4**
32	**6**	33	**7**	35	**7**	40	**7**	80	**4**
8	3	16	4	12	**4**	15	**4**		
				14	3	18	3	20	**3**
				10	**3**	12	**3**	15	**2**
								200	**7**
								200	**7**
				95	7	120	7	150	**6**
				75	8	95	8	120	**6**
								180	**5**
50	5			90	6	100	6	80	**5**
								180	5
60	5			50	6	55	6	180	5
50	5	50	5					120	5
45	4	44	5	48	5	60	5	120	5
40	4	33	5	45	5	55	5	70	4
32	4	28	5	38	**5**	45	**5**	50	3
25	**4**							50	4
				38	6	48	6	40	3
								80	3

≤10×D drilling depth

Order no. R / Order no. L	81210	81317	81310 81315	82210	81320	81330	81350	81340
Standard	339	340	340	341	340	340	340	340
Tool material	HSS							
Surface								
Type	N	N	N	N	H	W	FW	FN

v_c m/min	Feed col. no.							
24	6	6	6	6				**6**
20	5	5	5	5				**5**
27	6	6	6	6				**6**
27	5	5	5	5				5
22	5	5	5	5				**5**
22	5	5	5	5				**5**
27	6	6	6	6				**6**
14	4	4	4	4				4
27	6	6	6	6				**6**
27	6	6	6	6				6
22	6	6	6	6				**6**
18	6	6	6	6				6
65						**7**	**7**	
65						**7**	**7**	
45	7	7	7	7		7		**7**
45	6	6	6	6				**6**
63	6	6	6	6	6		**6**	
54	5	5	5	5		5		**5**
63					**6**			
36	5	5	5	5				**5**
28	4	4	4	4	**4**			
22	4	4	4	4				
22	4	4	4	4				**4**
14	4	4	4	4	4			**4**
22	5	5	5	5	**5**	5	5	

84814	84812	84418	84423	84506
340	340	340	340	340
HSS-E		HSS		HSS
○	T	T	T	F
FU 500 DZ	FU 500 DZ	N	FN	FN



v_c m/min	Feed col. no.		v_c m/min	Feed col. no.		v_c m/min	Feed col. no.
32	6	6	28	6	**6**	30	**7**
25	5	5	22	5	**5**	24	**6**
35	6	6	30	6	**6**	33	**7**
28	6	6	30	5	5	33	6
28	6	6	25	5	**5**	28	**6**
25	6	6	25	5	**5**	28	**6**
15	5	5	22	4	4	24	5
13	4	4	18	4	4	23	5
12	3	3					
28	6	6	30	6	**6**	33	**7**
14	4	4	14	4	4	18	5
12	3	3					
13	4	4	12	4	4	15	5
8	3	3					
13	4	4	16	4	4	19	5
10	3	3	10	3	3	13	4
10	3	3					
13	4	4					
8	4	4					
12	4	4					
32	6	6	30	6	**6**	33	**7**
26	6	6	30	6	6	33	7
28	6	6	24	6	**6**	26	**7**
20	6	6	20	6	6	22	7
50	7	7					
50	7	7					
60	7	7	50	7	**7**	55	**8**
50	6	6	50	6	**6**	55	**7**
50	6	6	70	6			
24	5	5	60	5	**5**	65	**6**
50	5	5					
28	5	5	40	5	**5**	44	**6**
35	4	4	30	**4**			
25	4	4	25	**4**			
24	4	4	14	4	**4**	16	**5**
20	4	4	12	4	4	14	5
18	4	4	18	4	**4**	23	**5**
12	4	4	32	5			

≤10×D drilling depth

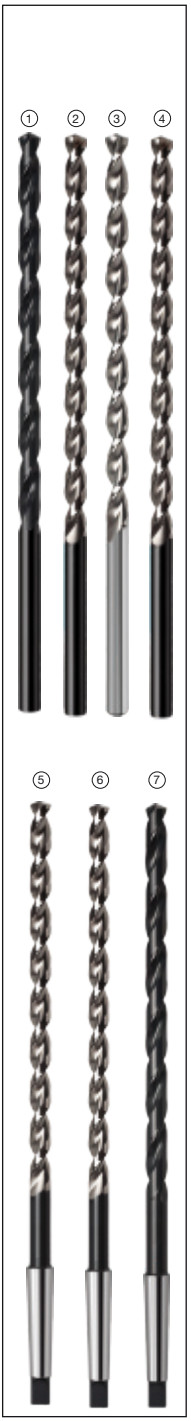
Order no. R	81311	82211	81341	81361	81362	89286
Order no. L						
Standard	340	341	340	340	340	WN
Tool material	HSS-E				HSS-E	Solid carb.
Surface					T	
Type	N	N	FN	S	S	N

v_c m/min	Feed col. no.				v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
33	5	5	5					
27	5	5	5					
36	5	5	5					
32	5	5	**5**					
36	5	5	5					
36	5	5	5					
22	4	4	**4**					
18	4	4	**4**					
14	3	3	**3**	3	*15*	3		
32	5	5	5					
18	4	4	**4**					
13	3	3	**3**		*13*	3		
14	4	4	**4**					
10	3	3	**3**		*10*	3		
13	4	4	**4**					
10	3	3	**3**		*10*	3		
12	3	3	**3**		*10*	3		
6	2	2	2		*8*	**2**		
12	4	4	**4**	4	*15*	4		
8	3	3	2	**3**	*10*	**3**		
10	3	3	**3**	**3**	*13*	**3**		
4			1					
5	1	1		1	*6*	1		
32	6	6	6					
27	6	6	**6**					
26	6	6	6					
24	6	6	**6**					
6	3	3	3	3	*6*	**3**		
8				**2**	*10*	**2**		
5				**2**	*6*	**2**		
70			7					
60			6					
60				5				
36	5	5	5					
54			5					
36	5	5	5					
30	4	4	5					
24	4	4	5					
18	4	4	4					
13	4	4	**4**	4	*25*	4		
16	4	4	4				*50*	**4**
26				4			*40*	**3**
							80	**3**

>10×D drilling depth

Order no. R	81410 81510 81610	82310 82410	81450	81440 81540 81640	81740 81750 81760	82340 82440	82466 82467 82468 82469
Standard	1869	1870	1869	1869	WN	1870	WN
Tool material	HSS						
Surface							
Type	N	N	FW	FN	FN	FN	FN
	pict. 1	pict. 7	pict. 3	pict. 2	pict. 4	pict. 6	pict. 5

v_c m/min	Feed col. no.						
22	5	5		**5**	**5**	**5**	**5**
18	4	4		**4**	**4**	**4**	**4**
22	5	5		**5**	**5**	**5**	**5**
18	4	4		4	4	4	4
22	4	4		**4**	**4**	**4**	**4**
18	4	4		**4**	**4**	**4**	**4**
12	3	3					
22	5	5		**5**	**5**	**5**	**5**
10	3	3					
8	3	3					
12	3	3		3	3	3	3
6	2	2		2	2	2	2
6	2	2					
22	5	5		**5**	**5**	**5**	**5**
18	5	5		5	5	5	5
20	5	5		**5**	**5**	**5**	**5**
14	5	5		5	5	5	5
55			6				
55			6				
45	6	6		**6**	**6**	**6**	**6**
36	5	5		**5**	**5**	**5**	**5**
55	5	5	5	**5**	**5**	**5**	**5**
22	4	4		**4**	**4**	**4**	**4**
45	4	4					
28	4	4		**4**	**4**	**4**	**4**
22	3	3		3	3	3	3
20	3	3		**3**	**3**	**3**	**3**
18	3	3		**3**	**3**	**3**	**3**
12	3	3		**3**	**3**	**3**	**3**
18	4	4	4	4	4	4	4



>10×D drilling depth

Order no. R	**84425**	**81441**
Order no. L	**84426**	**81541**
Standard	1869	1869
Tool material	**HSS**	**HSS-E**
Surface	T	
Type	FN	FN
	picture 1	picture 2

v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
28	**5**	*30*	4
22	**4**	*25*	4
28	**5**	*33*	4
22	**4**	*30*	**4**
28	**4**	*33*	4
22	**4**	*33*	4
16	**3**	*20*	**3**
		14	**3**
		10	**2**
28	**5**	*29*	4
		14	**3**
		10	**2**
		10	**3**
		8	**2**
12	**3**	*11*	**3**
8	**2**	*8*	**2**
		8	**2**
		5	**1**
		10	**3**
		8	**2**
		10	**2**
		3	1
6	1	*5*	**1**
28	**5**		
22	**5**	*20*	**5**
25	**5**		
18	5	*16*	**5**
		5	2
		6	**1**
		5	**1**
70	6		
70	6		
55	**6**	*50*	6
45	**5**	*40*	5
70	**5**		
28	**4**	*30*	4
		45	4
36	**4**	*30*	4
28	3	*25*	4
25	**3**	*20*	4
22	**3**	*16*	3
18	**3**	*10*	**3**
15	**3**	*14*	3
22	4	*20*	3

≤10×D drilling depth

>10×D

Order no. R	82710	82521	82535	82525	82515
Standard	Hartner	Hartner	Hartner	Hartner	Hartner
Tool material	HSS			HSS-E	HSS-E
Surface	○	●	●	●	●
Type	FN	N	FN	FN	FN
Cooling	with	with	with	with	with



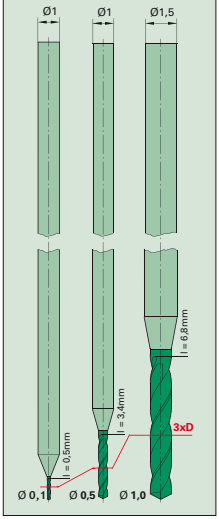


v_c m/min	Feed col. no.			v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
26	6	6	6	35	6	30	**5**
22	5	5	5	30	5	25	**4**
30	6	6	6	30	6	30	**5**
30	**5**	**5**	**5**	30	5	25	**4**
24	**5**	**5**	**5**	35	5	30	**4**
24	**5**	**5**	**5**	29	5	25	**4**
22	4	4	4	22	**4**	18	**3**
20	4	4	4	18	**4**	16	**3**
14	3	3	3	14	**3**	12	**2**
30	**6**	**6**	**6**	35	6	30	**5**
17	4	4	4	18	**4**	16	**3**
12	3	3	3	14	**3**	12	**2**
14	4	4	4	14	**4**	12	**3**
10	3	3	3	12	**3**	10	**2**
15	**4**	**4**	**4**	15	4	13	**3**
10	3	3	3	11	**3**	9	**2**
10	3	3	3	11	**3**	9	**2**
7	2	2	2	8	**2**	6	**2**
				14	**4**	12	**3**
				10	3	8	**2**
				12	**3**	12	**2**
				4	2	4	**1**
				8	**1**	6	**1**
30	**6**	**6**	**6**	30	6	28	**5**
30	6	6	6	24	**6**	22	**5**
24	**6**	**6**	**6**	24	6	22	**5**
20	6	6	6	20	**6**	18	**5**
7	3	3	3	8	3	6	**2**
				10	**2**	8	**2**
				8	**2**	6	**2**
80	**6**						
50	**7**	**7**	**7**	60	7	55	**6**
50	**6**	**6**	**6**	50	6	44	**5**
60	**5**	**5**	**5**	38	5	35	**4**
				55	5	50	4
40	**5**	**5**	**5**	36	5	33	**4**
24	**4**	**4**	**4**	24	4	22	**4**
24	**4**	**4**	**4**	20	**4**	18	**4**
22	4	4	4	14	**4**	12	**4**
24	**5**	**5**	**5**	25	5	25	**4**

Drill-Ø mm	Feed column no. for order no. 87011 / 87016 / 84810 / 89281								
	101	102	103	104	105	106	107	108	109
	f (mm/rev.)								
0.10	0.002	0.003	0.003	0.004	0.006	0.007	0.010	0.013	0.016
0.16	0.002	0.003	0.004	0.005	0.007	0.009	0.012	0.016	0.022
0.25	0.003	0.004	0.005	0.007	0.009	0.011	0.014	0.019	0.024
0.30	0.004	0.005	0.007	0.009	0.011	0.015	0.019	0.025	0.033
0.50	0.005	0.007	0.008	0.011	0.014	0.019	0.024	0.031	0.041
0.63	0.007	0.009	0.012	0.015	0.020	0.026	0.034	0.044	0.057
0.80	0.010	0.013	0.016	0.020	0.024	0.031	0.038	0.048	0.060
1.00	0.020	0.024	0.029	0.035	0.041	0.050	0.060	0.072	0.086
1.50	0.030	0.035	0.040	0.046	0.052	0.060	0.069	0.080	0.092
2.00	0.040	0.046	0.053	0.061	0.070	0.080	0.093	0.106	0.122

Order no. R	**87011**	**84810**	**89281**
Order no. L	**87016**		
Standard	1899	1899	WN
Tool material	**HSS-E PM**	**HSS-E PM**	**Solid carb.**
Surface	○	Ⓣ	○
Type	N	N	N

Micro Drill geometries to DIN 1899 measures in mm



v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
21	106	*27*	106	*50*	105
18	105	*23*	105	*35*	104
18	106	*23*	106	*50*	**105**
16	105	*21*	105	*45*	**104**
20	105	*26*	105	*45*	104
18	105	*23*	105	*35*	104
14	**104**	*18*	**104**	*30*	103
14	**104**	*18*	**104**	*30*	103
12	103	*16*	103		
18	106	*23*	106	*50*	103
14	**104**	*18*	**104**	*40*	103
12	103	*16*	103		
14	**104**	*18*	**104**	*25*	103
12	103	*16*	103		
16	**104**	*20*	**104**	*25*	103
14	103	*18*	103		
14	103	*18*	103		
8	102	*10*	102	*20*	102
18	104	*20*	104	*25*	**103**
14	103	*16*	103	*25*	**102**
16	103	*18*	103	*25*	**102**
				15	104
				15	**103**
26	106	*33*	106	*80*	**105**
22	**106**	*28*	**106**	*60*	**105**
18	106	*23*	106	*60*	105
22	**106**	*28*	**106**	*50*	**105**
				45	**104**
				25	**104**
				160	**107**
				150	**106**
26	107			*100*	**106**
18	106			*60*	**106**
75	106	*80*	106	*150*	**105**
42	105	*53*	105	*50*	**105**
				67	106
22	105	*28*	105	*44*	104
22	104	*28*	104	*68*	103
18	104	*23*	104	*49*	103
13	104	*16*	104	*53*	103
		14	104	*36*	103
16	104	*20*	104	*50*	103
18	104	*23*	104	*36*	103
				60	104

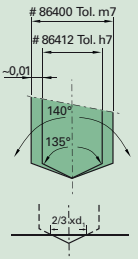
Drill-Ø mm	Feed column no. for order no. 86400 / 86401 / 86408 / 86412												
	56	57	58	59	60	61	62	63	64	65	66	67	68
	f (mm/rev.)												
0.80	0.008	0.016	0.024	0.032	0.04	0.05	0.06	0.07	0.08	0.08	0.08	0.09	0.09
1.00	0.012	0.022	0.032	0.042	0.06	0.07	0.08	0.09	0.10	0.10	0.11	0.11	0.12
1.50	0.021	0.036	0.051	0.066	0.09	0.10	0.12	0.13	0.15	0.15	0.16	0.17	0.18
2.00	0.032	0.052	0.072	0.092	0.12	0.14	0.16	0.18	0.20	0.21	0.22	0.23	0.24
2.50	0.045	0.070	0.095	0.012	0.15	0.17	0.20	0.22	0.25	0.26	0.27	0.28	0.30
3.00	0.060	0.090	0.120	0.0150	0.18	0.21	0.24	0.27	0.30	0.31	0.33	0.34	0.36

Order no. R	86402	86400	86401	86408	86412
Standard	Hartner	Hartner	Hartner	Hartner	Hartner
Tool material	Solid carbide			Solid carbide	
Surface	A	A	A	A	A
Type	N	N	N	N	N
Cooling	without	without	without	with	with

v_c m/min	Feed col. no.		
100	**62**	**64**	**62**
100	**62**	**64**	**62**
100	**62**	**64**	**62**
90	**61**	**63**	**61**
90	**62**	**64**	**62**
90	**62**	**64**	**62**
90	**61**	**63**	**61**
90	**61**	**63**	**61**
70	**60**	**62**	**60**
100	**61**	**63**	**61**
85	**61**	**63**	**61**
70	**60**	**62**	**60**
70	**60**	**62**	**60**
60	**60**	**62**	**60**
50	**60**	**62**	**60**
60	**60**	**62**	**60**
130	**66**	**68**	**66**
130	**66**	**68**	**66**
130	**66**	**68**	**66**
120	**65**	**67**	**65**

v_c m/min	Feed col. no.	
105	**58**	**58**
100	**58**	**58**
105	**59**	**59**
90	**59**	**59**
95	**58**	**58**
95	**58**	**58**
90	**58**	**58**
90	**58**	**58**
70	**58**	**58**
100	**57**	**57**
85	**58**	**58**
70	**58**	**58**
70	**57**	**57**
60	**57**	**57**
50	**58**	**58**
50	**58**	**58**
50	**57**	**57**
50	57	57
70	**57**	**57**
60	**56**	**56**
70	**57**	**57**
25	56	56
150	**60**	**60**
140	**60**	**60**
140	**60**	**60**
130	**60**	**60**
35	56	56
35	56	56
70	68	68
70	68	68
135	59	59
135	59	59

Pilot drilling:
For the application of solid carbide micro-precision drills 15xD we recommend a pilot hole 1xD up to 2xD depth. For this pilot hole, the solid carbide micro-precision drill 4xD is optimally suitable. Its point angle and its diameter tolerance are perfectly adapted.
Centering: in order to achieve full performance with solid carbide micro-precision drills from 8xD drilling depth, we recommend centering. The micro-precision drill up to 4xD, order no. 86400, can be applied for this purpose. The centering diameter should be approximately $^2/_3$ xD.
Filter quality: When applying solid carbide micro-precision drills we recommend constant monitoring of the lubricant's filter quality due to the extremely small coolant duct diameters,



≤3×D drilling depth

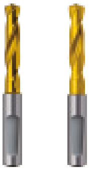
Order no. R	89264	89237	89403	89422
Standard	6537K	6539	6537K	6537K
Tool material	Solid carbide		Solid carbide	Solid carbide
Carbide grade	K/P	K/P	K/P	K/P
Surface	T	T	F	Y
Type	TS 100 **U**	TS 100 **U**	TS 100 **F**	TS 100 **H**
Shank form	HE	DZ	HA	HA
Cooling	without	without	without	without




v_c m/min	Feed col. no.		v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
100	**6**	**6**	130	7	130	**7**
85	**5**	**5**	110	6	110	**6**
110	**7**	**7**	145	8	145	**8**
85	**6**	**6**	110	7	110	**7**
90	**6**	**6**	120	7	120	**7**
85	**6**	**6**	110	7	110	**7**
80	**6**	**6**	105	7	105	**7**
80	**6**	**6**	105	7	105	**7**
75	**5**	**5**	100	6	100	**6**
100	**7**	**7**	130	8	130	**8**
90	**6**	**6**	120	7	120	**7**
65	**4**	**4**	85	5	85	**5**
75	5	5	100	**6**	100	**6**
70	4	4	90	**5**	90	**5**
50	5	5	65	**6**	65	**6**
40	4	4	55	**5**	55	**5**
			55	**4**	55	**4**
35	2	2	45	**3**	45	**3**
40	3	3	55	**4**		
35	3	3	45	**4**		
35	2	2	45	**3**		
35	2	2	45	**3**	45	**3**
20	1	1	25	**2**	25	2
20	3	3	25	**4**	25	**4**
160	**7**	**7**	210	8		
120	**7**	**7**	155	8		
120	**6**	**6**	155	8		
95	**6**	**6**	125	8		
25	**2**	**2**	35	**3**		
30	3	3	40	**3**	40	3
25	2	2	35	**3**	35	3
200	**8**	**8**	260	**9**		
200	**8**	**8**	260	**9**		
170	**8**	**8**	220	**9**		
140	**7**	**7**	180	**8**		
200	**7**	**7**	260	8		
80	6	6	105	**7**		
210	7	7	270	**8**		
140	**6**	**6**	180	7		
80	**5**	**5**	105	6		
65	**5**	**5**	85	6		
60	**4**	**4**	80	5		
45	**4**	**4**	60	5		

	89413	89402	89401		89450	89550		89265	89266
	6537K	6537K	6539		6537K	6537K		6537K	6537K
	Solid carbide				Solid carbide			Solid carbide	
	K/P	K/P	K/P		K	K		K/P	K/P
	F	F	F		a	a		T	T
	TS100 **U**	TS100 **U**	TS100 **U**		TS 100 **INOX**			TS100 **F**	TS100 **U**
	HA	HE	DZ		HA	HE		HE	HE
	without	without	without		with	with		with	with





v_c m/min	**Feed col. no.**			v_c m/min	**Feed col. no.**		v_c m/min	**Feed col. no.**	
130	**7**	**7**	**7**				*110*	6	**6**
110	**6**	**6**	**6**				*90*	5	**5**
145	**8**	**8**	**8**				*130*	7	**7**
110	**7**	**7**	**7**				*110*	7	**7**
120	**7**	**7**	**7**				*100*	7	**7**
110	**7**	**7**	**7**				*95*	6	**6**
105	**7**	**7**	**7**				*90*	6	**6**
105	**7**	**7**	**7**				*90*	6	**6**
100	**6**	**6**	**6**				*80*	6	**6**
130	**8**	**8**	**8**				*110*	7	**7**
120	**7**	**7**	**7**				*90*	6	**6**
85	**5**	**5**	**5**				*65*	4	**4**
100	6	6	6				*85*	**6**	6
90	5	5	5				*80*	**4**	5
65	6	6	6				*60*	**5**	5
55	5	5	5				*50*	**4**	4
							45	**3**	3
45	3	3	3				*45*	**2**	2
55	4	4	4	*80*	**5**	**5**	*45*	**4**	4
45	4	4	4	*60*	**2-3**	**2-3**	*40*	**4**	4
45	3	3	3	*80*	**5**	**5**	*35*	**4**	4
45	3	3	3				*40*	**2**	2
25	2	2	2				*25*	**1**	1
25	4	4	4	*30*	2	2	*25*	**3**	3
210	**8**	**8**	**8**				*160*	8	**8**
155	**8**	**8**	**8**				*120*	8	**8**
155	**7**	**7**	**7**				*100*	8	**8**
125	**7**	**7**	**7**				*95*	7	**7**
35	**3**	**3**	**3**				*30*	2	**2**
40	4	4	4	*35*	2	2	*35*	**3**	3
35	3	3	3				*30*	**2**	2
260	**9**	**9**	**9**				*240*	8	**8**
260	**9**	**9**	**9**				*240*	8	**8**
220	**8**	**8**	**8**				*200*	8	**8**
180	**8**	**8**	**8**				*170*	8	**8**
260	**8**	**8**	**8**				*230*	7	**7**
105	7	7	7				*95*	**6**	6
270	8	8	8				*250*	**7**	7
180	**7**	**7**	**7**				*170*	6	**6**
105	**6**	**6**	**6**				*95*	6	**6**
85	**6**	**6**	**6**				*80*	5	**5**
80	**5**	**5**	**5**				*70*	5	**5**
60	**5**	**5**	**5**				*60*	5	**5**

≤3×D drilling depth

Order no. R	89405	89410	89415	89423	89424	89238
Standard	6537K	6537K	6537K	6537K	6537K	6539
Tool material	Solid carbide			Solid carbide		Solid carb.
Carbide grade	K/P	K/P	K/P	K/P	K/P	K
Surface	F	F	F	Y	Y	○
Type	TS 100 **F**	TS 100 **U**	TS 100 **U**	TS 100 **H**	TS 100 **H**	TS 3 **G**
Shank form	HE	HA	HE	HA	HE	DZ
Cooling	with	with	with	with	with	without



v_c m/min	Feed col. no.			v_c m/min	Feed col. no.		v_c m/min	Feed col. no.
145	7	7	7	*145*	**7**	**7**		
120	6	6	6	*120*	**6**	**6**		
170	8	8	8	*170*	**8**	**8**		
145	8	8	8	*145*	**8**	**8**		
130	8	8	8	*130*	**8**	**8**		
125	7	7	7	*125*	**7**	**7**		
120	7	7	7	*120*	**7**	**7**		
120	7	7	7	*120*	**7**	**7**		
105	7	7	7	*105*	**7**	**7**		
145	8	8	8	*145*	**8**	**8**		
120	7	7	7	*120*	**7**	**7**		
85	5	5	5	*85*	**5**	**5**		
110	**7**	**7**	**7**	*110*	**7**	**7**		
105	**5**	**5**	**5**	*105*	**5**	**5**		
80	**6**	**6**	**6**	*80*	**6**	**6**		
65	**5**	**5**	**5**	*65*	**5**	**5**		
60	**4**	**4**	**4**	*60*	**4**	**4**		
60	**3**	**3**	**3**	*60*	**3**	**3**		
60	**5**	**5**	**5**					
55	**5**	**5**	**5**					
45	**5**	**5**	**5**					
55	**3**	**3**	**3**	*55*	**3**	**3**		
35	**2**	**2**	**2**	*35*	2	2		
35	**4**	**4**	**4**	*35*	**4**	**4**		
210	9	9	9				*100*	6
160	9	9	9				*80*	6
140	9	9	9				*80*	6
130	8	8	8				*70*	6
40	3	3	3					
45	**4**	**4**	**4**	*45*	4	4		
40	**3**	**3**	**3**	*40*	3	3		
310	9	9	9				*180*	7
310	9	9	9				*160*	7
260	9	9	9				*150*	7
220	9	9	9				*120*	6
280	8	8	8				*180*	6
125	**7**	**7**	**7**					
325	**8**	**8**	**8**				*180*	6
220	7	7	7					
125	7	7	7					
105	6	6	6					
90	6	6	6					
80	6	6	6					

≤4×D ≤5×D drilling depth

89292	89307	89420	89451	89551
WN	6538M	6537L	6537L	6537L
Solid carb.	Carbide	Solid carb.	Solid carbide	
K	P	P	K	K
○	T	F	a	a
TS 150 **GG**	TS 80 **U**	TS 100 **R**	TS 100 **INOX**	
HA	HE	HA	HA	HE
with	with	with	with	with





v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	
		95	5					
		80	4					
		95	6					
		75	5					
		80	5					
		75	5					
		75	5					
		75	5					
		55	4					
		90	6					
		75	5					
		55	4					
		70	5					
		55	4					
		40	4					
		35	4					
		40	3					
		40	2			*80*	**5**	**5**
		35	2			*60*	**2-3**	**2-3**
		35	2			*80*	**5**	**5**
						30	2	2
120	7	*150*	6	*210*	**9**			
100	7	*110*	6	*160*	**9**			
90	7	*110*	6	*160*	**9**			
80	7	*90*	5	*130*	**8**			
40	2							
						35	2	2
410	**9**	*200*	7					
410	**9**	*200*	7					
380	**9**	*170*	7					
330	**9**	*140*	6					
280	9							
110	6							
80	5							
				130	**8**			
				100	**8**			
				80	**8**			
				60	**8**			

≤5×D drilling depth

Order no. R	89275	89404	89414	89417
Standard	Hartner	6537L	6537L	6537L
Tool material	Solid carbide	Solid carbide	Solid carbide	
Carbide grade	K/P	K/P	K/P	K/P
Surface	T	F	F	F
Type	TS 100 **U**	TS 100 **F**	TS 100 **U**	
Shank form	DZ	HA	HA	HE
Cooling	without	without	without	without




v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	
100	**6**	130	7	130	**7**	**7**
85	**5**	110	6	110	**6**	**6**
110	**7**	145	8	145	**8**	**8**
85	**6**	110	7	110	**7**	**7**
90	**6**	120	7	120	**7**	**7**
85	**6**	110	7	110	**7**	**7**
80	**6**	105	7	105	**7**	**7**
80	**6**	105	7	105	**7**	**7**
75	**5**	100	6	100	**6**	**6**
100	**7**	130	8	130	**8**	**8**
90	**6**	120	7	120	**7**	**7**
65	**4**	85	5	85	**5**	**5**
75	5	100	**6**	100	6	6
70	4	90	**5**	90	5	5
50	5	65	**6**	65	6	6
40	4	55	**5**	55	5	5
		55	**4**			
35	2	45	**3**	45	3	3
40	3	55	**4**	55	4	4
35	3	45	**4**	45	4	4
35	2	45	**3**	45	3	3
35	2	45	**2**	45	3	3
20	1	25	**2**	25	2	2
20	3	25	**4**	25	4	4
160	**7**	210	8	210	**8**	**8**
120	**7**	155	8	155	**8**	**8**
120	**6**	145	8	145	**7**	**7**
95	**6**	125	8	125	**7**	**7**
25	**2**	35	3	35	**3**	**3**
30	3	40	**3**	40	4	4
25	2	35	**3**	35	3	3
200	**8**	260	9	260	**9**	**9**
200	**8**	260	9	260	**9**	**9**
170	**8**	235	9	235	**9**	**9**
140	**7**	170	8	170	**8**	**8**
200	**7**	260	8	260	**8**	**8**
80	6	105	**7**	105	7	7
210	7	270	**8**	270	**8**	**8**
140	**6**	180	7	180	**7**	**7**
80	**5**	105	6	105	**6**	**6**
65	**5**	85	6	85	**6**	**6**
60	**4**	80	5	80	**5**	**5**
45	**4**	60	5	60	**5**	**5**

89271	89272
6537L	6537L
Solid carbide	
K/P	K/P
T	T
TS 100 **F**	TS 100 **U**
HE	HE
with	with

89407	89406	89411	89408
6537L	6537L	6537L	6537L
Solid carbide			
K/P	K/P	K/P	K/P
E	E	E	E
TS 100 **F**		TS 100 **U**	
HA	HE	HA	HE
with	with	with	with

89425	89426
6537L	6537L
Solid carbide	
K/P	K/P
Y	Y
TS 100 **H**	
HA	HE
with	with

v_c m/min	Feed col. no.	
110	6	**6**
90	5	**5**
130	7	**7**
110	7	**7**
100	7	**7**
95	6	**6**
90	6	**6**
90	6	**6**
80	6	**6**
110	7	**7**
90	6	**6**
65	4	**4**
85	**6**	6
80	**4**	**5**
60	**5**	5
50	**4**	4
45	**3**	4
45	**2**	2
45	**4**	4
40	**4**	4
35	**4**	4
40	**2**	2
25	**1**	1
25	**3**	3
160	8	**8**
120	8	**8**
100	8	**8**
95	7	**7**
30	2	**2**
35	**3**	3
30	**2**	2
240	8	**8**
240	8	**8**
200	8	**8**
170	8	**8**
230	7	**7**
95	**6**	6
250	**7**	7
170	6	**6**
95	6	**6**
80	5	**5**
70	5	**5**
60	5	**5**

v_c m/min	Feed col. no.			
145	7	7	**7**	7
120	6	6	**6**	6
170	8	8	**8**	8
145	8	8	**8**	8
130	8	8	**8**	8
125	7	7	**7**	7
120	7	7	**7**	7
120	7	7	**7**	7
105	7	7	**7**	7
145	8	8	**8**	8
120	7	7	**7**	7
85	5	5	**5**	5
110	**7**	**7**	7	**7**
105	**5**	**5**	5	**5**
80	**6**	**6**	6	**6**
65	**5**	**5**	5	**5**
60	**4**	**4**	5	**4**
60	**3**	**3**	3	**3**
60	**5**	**5**	5	**5**
55	**5**	**5**	5	**5**
45	**5**	**5**	5	**5**
55	**3**	**3**	3	**3**
35	**2**	**2**	2	**2**
35	**4**	**4**	4	**4**
210	9	9	**9**	9
160	9	9	**9**	9
140	9	9	**9**	9
130	8	8	**8**	8
40	3	3	3	3
45	**4**	**4**	4	**4**
40	**3**	**3**	3	**3**
310	9	9	**9**	9
310	9	9	**9**	9
260	9	9	**9**	9
220	9	9	**9**	9
280	8	8	**8**	8
125	**7**	**7**	7	**7**
325	**8**	**8**	8	**8**
220	7	7	**7**	7
125	7	7	**7**	7
105	6	6	**6**	6
90	6	6	**6**	6
80	6	6	**6**	6

v_c m/min	Feed col. no.	
145	7	**7**
120	**6**	**6**
170	8	**8**
145	**8**	**8**
130	8	**8**
125	7	**7**
120	**7**	**7**
120	**7**	**7**
105	**7**	**7**
145	8	**8**
120	**7**	**7**
85	**5**	**5**
110	**7**	**7**
105	**5**	**5**
80	**6**	**6**
65	**5**	**5**
60	**4**	**4**
60	**3**	**3**
55	**3**	**3**
35	2	2
35	**4**	**4**
45	4	4
40	3	3

≤5×D drilling depth

Order no. R	89239	89247	89241
Standard	6539	6537L	6539
Tool material	Solid carbide		Solid carb.
Carbide grade	K	K	K10/K20
Surface	○	○	T
Type	TS 3 **G**	TS 3 **G**	TS 3 **F**
Shank form	DZ	HA	DZ
Cooling	without	without	without

v_c m/min	Feed col. no.		v_c m/min	Feed col. no.
			100	5
			85	4
			110	6
			95	5
			90	5
			85	5
			80	5
			80	5
			70	4
			100	6
			80	5
			70	4
			75	4
			70	4
			50	4
			40	4
			35	3
100	6	**6**	*140*	6
80	6	**6**	*100*	6
80	6	**6**	*100*	6
70	6	**6**	*90*	6
180	7	**7**	*200*	7
160	7	**7**	*180*	7
150	7	**7**	*170*	7
120	6	**6**	*140*	6
180	6	**6**	*200*	6
180	6	**6**	*210*	6

≤7×D drilling depth

Order no. R	89294	89421
Standard	Hartner	Hartner
Tool material	Solid carb.	Solid carb.
Carbide grade	K	P
Surface	○	F
Type	TS 150 **GG**	TS 100 **R**
Shank form	HA	HA
Cooling	with	with

v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
120	6	*210*	**8**
100	6	*160*	**8**
90	6	*160*	**8**
80	6	*130*	**7**
40	2		
410	8		
410	8		
380	**8**		
330	**8**		
280	7		
110	6		
80	5		
		130	**7**
		100	**7**
		80	**7**
		60	**7**

≤10×D

12D

89412	89416	89293	89427	89418
Hartner	Hartner	Hartner	Hartner	Hartner
Solid carbide		**Solid carb.**	**Solid carb.**	**Solid carbide**
K/P	K/P	K	K/P	K
F	F	○	V	F coated head
TS 100 **U**	TS 100 **U**	TS 150 **GG**	TS 100 **H**	TS 100 **U**
HA	HE	HA	HA	HA
with	with	with	with	with

v_c m/min	Feed col. no.		v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
145	**6**	**6**			145	**6**	110	**8**
120	**5**	**5**			120	**5**	110	**8**
170	**7**	**7**			170	**7**	120	**8**
145	**7**	**7**			145	**7**	120	**8**
130	**7**	**7**			130	**7**	110	**6**
125	**6**	**6**			125	**6**	110	**8**
120	**6**	**6**			120	**6**	100	**7**
120	**6**	**6**			120	**6**	110	**7**
105	**6**	**6**			105	**6**	110	**6**
145	**7**	**7**			145	**7**	110	**8**
120	**6**	**6**			120	**6**	110	7
85	**4**	**4**			85	**4**	110	6
110	6	6			110	**6**	100	5
105	4	4			105	**4**	80	5
80	5	5			80	**5**	100	6
65	4	4			65	**4**	80	5
60	4	4			60	**3**	50	5
60	2	2			60	**2**	50	5
60	4	4					100	5
55	4	4					60	3
45	4	4					100	5
55	2	2			55	**2**	50	4
35	1	1			35	1		
35	3	3			35	**3**	30	2
195	**8**	**8**	120	6			140	**8**
160	**8**	**8**	100	6			100	**8**
140	**8**	**8**	90	6			140	**8**
130	**7**	**7**	80	6			100	**8**
40	2	2	40	1				
40	3	3			45	3		
40	2	2			40	4		
310	**8**	**8**	410	8				
310	**8**	**8**	410	8				
260	**8**	**8**	380	**8**			220	**7**
220	**8**	**8**	330	**8**			180	**7**
280	**7**	**7**						
125	6	6					120	1
325	7	7	280	7			120	8
220	6	6						
125	**6**	**6**	110	6				
105	**5**	**5**	80	5				
90	**5**	**5**						
80	**5**	**5**						

≤15×D

Order no. R	**86509**
Standard	Hartner
Tool material	**Solid carbide**
Carbide grade	K30/K40
Surface	A coated head
Type	TS 100 **T**

≤20×D

86511	
Hartner	
Solid carbide	
K30/K40	
A coated head	
TS 100 **T**	

Cooling	conv. min. 40 bar		MQL		conv. min. 40 bar		MQL	
	v_c m/min	**Feed col. no.**	v_c m/min	**Feed col. no.**	v_c m/min	**Feed col. no.**	v_c m/min	**Feed col. no.**
	110	8			*110*	**8**		
	110	8			*110*	**8**		
	120	8			*120*	**8**		
	120	8			*120*	**8**		
	110	6			*110*	**6**		
	110	8			*110*	**8**		
	100	7			*100*	**7**		
	110	7	*80*	7	*110*	**7**	*80*	7
	110	6	*80*	7	*110*	**6**	*80*	7
	110	8			*110*	**8**		
	110	7	*80*	6-7	*110*	**7**	*80*	6-7
	110	6	*80*	6-7	*110*	**6**	*80*	6-7
	100	5			*100*	**5**		
	80	5			*80*	**5**		
	100	6-7			*100*	**6**		
	80	5			*80*	**5**		
	50	5			*50*	**5**		
	50	5			*50*	**5**		
	100	5			*100*	**5**		
	70	2-3			*60*	**3**		
	100	5			*100*	**5**		
	50	4			*50*	**4**		
	30	2			*30*	**2**		
	140	8			*140*	**8**		
	100	8			*100*	**8**		
	140	8			*140*	**8**		
	100	8			*100*	**8**		
	120	1			*120*	**1**		
	120	8			*120*	**8**		
	100	6			*100*	**6**		
	100	6			*100*	**6**		
	90	8	*90*	8	*90*	**8**	*90*	8

≤25×D

86512
Hartner
Solid carbide
K30/K40
A coated head
TS 100 **T**

conv. min. 40 bar		MQL	
v_c m/min	**Feed col. no.**	v_c m/min	**Feed col. no.**
100	**8**		
100	**8**		
120	**8**		
100	**8**		
110	**6**		
100	**8**		
100	**7**		
100	**7**	*70*	7
100	**6**	*70*	7
100	**8**		
100	**7**	*70*	6-7
100	**6**	*70*	6-7
80	**5**		
60	**5**		
90	**6**		
70	**4**		
50	**4**		
50	**4**		
100	**5**		
60	**3**		
100	**5**		
50	**4**		
30	**2**		
130	**8**		
90	**8**		
130	**8**		
90	**8**		
120	**1**		
110	**8**		
90	**6**		
90	**6**		
80	**8**	*80*	8

≤30×D

86513
Hartner
Solid carbide
K30/K40
A coated head
TS 100 **T**

conv. min. 40 bar		MQL	
v_c m/min	**Feed col. no.**	v_c m/min	**Feed col. no.**
80	**7**		
80	**7**		
100	**8**		
100	**8**		
110	**6**		
80	**7**		
80	**7**		
80	**7**	*60*	6-7
80	**6**	*60*	7
80	**7**		
80	**6**	*60*	6-7
80	**6**	*60*	6-7
80	**5**		
60	**5**		
80	**6**		
70	**4**		
50	**4**		
50	**4**		
80	**5**		
60	**3**		
80	**5**		
50	**4**		
30	**2**		
120	**8**		
80	**8**		
120	**8**		
80	**8**	*65*	8
120	**1**		
100	**8**		
80	**6**		
80	**6**		
70	**8**	*70*	8

≤40×D

86514
Hartner
Solid carbide
K30/K40
A coated head.
TS 100 **T**

conv. min. 40 bar	
v_c m/min	**Feed col. no.**
80	7
80	7
100	8
100	8
110	6
80	7
80	7
80	6-7
80	6
80	7
80	6
80	6
80	5
60	5
80	6-7
70	4
50	4
50	4
80	5
70	2-3
80	5
50	4
30	2
120	8
80	8
120	8
80	8
120	1
100	8
80	6
80	6
70	8

Drill-Ø mm	Feed column no.							
	11	12	13	14	15	16	17	18
	f (mm/rev.)							
1.50	0.002	0.004	0.006	0.008	0.012	0.020	0.032	0.045
2.00	0.003	0.005	0.007	0.010	0.016	0.028	0.046	0.055
2.50	0.004	0.006	0.008	0.012	0.018	0.030	0.054	0.070
4.00	0.005	0.007	0.010	0.016	0.025	0.043	0.065	0.085
6.00	0.007	0.009	0.013	0.024	0.035	0.061	0.085	0.120
8.00	0.010	0.014	0.022	0.032	0.045	0.068	0.100	0.150
10.00	0.012	0.016	0.028	0.040	0.055	0.075	0.120	0.160
14.00	0.020	0.025	0.035	0.050	0.065	0.085	0.130	0.180
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.

E 100

Single-fluted gun drill

Solid carbide

0.9 … 12.0

recomm. coating*	≤35×D		>35×D	
	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
	100	15	95	14
	85	15	80	14
	90	15	85	14
	80	15	75	14
	90	14	85	13
	80	14	75	13
	75	14	70	13
A	75	14	70	13
A	65	14	60	13
A	80	15	75	14
	75	14	70	13
	65	14	60	13
A	75	14	70	13
A	65	14	60	13
A	75	13	70	12
A	65	13	60	12
A	55	12	50	11
A	65	13	60	12
	55	14	50	13
A	45	14	40	13
	35	14	35	13
	30	13	25	12
	25	10	20	11
	35	12	30	11
	85	16	80	15
	80	16	75	15
	80	15	75	14
	70	15	65	14
	55	14	50	13
A	35	12	30	11
	30	12	25	11
	150	17	140	16
	120	17	115	16
	150	18	140	17
	130	18	120	17
	110	17	100	16
A	75	15	70	14
	120	18	115	17
	90	18	85	17
	95	17	90	16
	75	17	70	16
	70	17	65	16
	60	17	55	16
	75	15	70	14
	70	15	65	14
	60	14	55	13
	50	14	45	13

E 80

Single-fluted gun drill

Carbide head

2.0 … 40.0

recomm. coating*	≤35×D		>35×D	
	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
	100	14	95	13
T	85	14	80	13
	90	14	85	13
T	80	14	75	13
	90	13	85	12
T	80	13	75	12
	75	13	70	12
T	75	13	70	12
T	65	13	60	12
T	80	14	75	13
T	75	13	70	12
	65	13	60	12
C	75	13	70	12
	65	13	60	12
C	75	12	70	11
	65	12	60	11
C	55	11	50	11
C	65	12	60	12
	55	13	50	12
C	45	13	40	12
	35	13	35	12
	30	12	25	11
C	25	11	20	11
C	35	11	30	11
	85	15	80	14
	80	15	75	14
	80	14	75	13
	70	14	65	13
	55	13	50	12
C	35	11	30	11
	30	11	25	11
	150	16	140	15
	120	15	115	14
	150	16	140	15
	130	16	120	15
	110	16	100	15
C	75	14	70	13
	120	17	115	16
	90	17	85	16
	95	16	90	15
	75	16	70	15
	70	16	65	15
	60	16	55	15
	75	14	70	13
	70	14	65	13
	60	13	55	12
	50	13	45	12

Order no.	Description	Surface	Drilling depth	Diameter range
89501	Single-fluted gun drill E 100	○	80 mm	1.20 - 5.00
89502	Single-fluted gun drill E 100	○	160 mm	1.50 - 5.00
89503	Single-fluted gun drill E 100	○	45 mm	1.20 - 3.20
89504	Single-fluted gun drill E 100	○	120 mm	1.50 - 5.00
89505	Single-fluted gun drill E 80	T	20 x D	4.00 - 12.00
89506	Single-fluted gun drill E 80	T	40 x D	4.00 - 12.00
89507	Single-fluted gun drill E 80	T	80 x D	4.95 - 11.95
89508	Two-fluted gun drill Z 80	○	30 x D	8.00 - 12.00
89509	Single-fluted gun drill E 80	T	30 x D	4.00 - 12.00
89510	Single-fluted gun drill E 100	A	45 mm	2.00 - 3.20
89511	Single-fluted gun drill E 100	A	80 mm	2.00 - 5.00
89512	Single-fluted gun drill E 100	A	120 mm	2.00 - 5.00
89513	Single-fluted gun drill E 100	A	160 mm	2.00 - 8.00
89514	Single-fluted gun drill E 80	D	20 x D	3.97 - 12.70
89515	Single-fluted gun drill E 80	D	30 x D	3.97 - 12.70
89516	Single-fluted gun drill E 80	D	40 x D	3.97 - 12.70
89517	Single-fluted gun drill E 80	D	80 x D	3.97 - 12.70
89518	Two-fluted gun drill Z 80	○	30 x D	8.00 - 12.00
89520	Single-fluted gun drill E 100	a	25 x D	1.00 - 12.00
89521	Single-fluted gun drill E 100	a	50 x D	1.00 - 8.00
89522	Single-fluted gun drill E 100	a	75 x D	1.00 - 6.00
89530	Single-fluted gun drill E 800	T	30 x D	16.00 - 24.00

Z 80

Two-fluted gun drill

Carbide head

6.0 … 27.0

E 800

Single-fluted gun drill

with interchangeable inserts

2.0 … 40.0

Z 80 ≤35×D		Z 80 >35×D		recomm. coating*	E 800 ≤35×D		E 800 >35×D	
v_c m/min	Feed col. no.	v_c m/min	Feed col. no.		v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
				T	90	15	85	15
					80	15	75	15
				T	85	16	80	16
					75	16	70	16
					85	15	80	15
				T	80	15	75	15
					75	15	70	15
				T	75	15	70	15
					65	15	60	15
				T	80	15	75	15
				T	75	15	70	15
					70	15	65	15
				T	70	15	65	15
					60	15	55	15
				T	65	14	60	14
					60	14	55	14
				T	55	14	50	14
				T	65	15	60	15
					50	14	45	14
				P	45	14	40	14
					40	14	35	14
				T	30	13	25	13
					25	12	20	12
				P	25	13	20	13
85	18	80	17		85	16	80	16
80	18	75	17		80	16	75	16
75	17	70	16	T	75	16	70	16
70	17	65	16		70	16	65	16
65	16	60	15		55	15	50	15
				P	35	13	30	13
					30	12	25	12
120	18	115	17		140	16	135	16
110	18	105	17		125	16	120	16
135	18	130	17		170	17	165	17
120	17	115	16		140	17	135	17
					115	16	110	16
				P	75	15	70	15
130	18	125	17		120	17	115	17
120	18	115	17		90	17	85	17
110	17	105	16		95	17	90	17
110	17	105	16		75	17	70	17
95	17	90	16		70	17	65	17
95	17	90	16		60	17	55	17
					75	16	70	16
					70	16	65	16
					60	15	55	15
					50	15	45	15

Standard-, special point grinds and head forms at single-fluted gun drills

Die Arbeitsschritte beim Tiefbohren

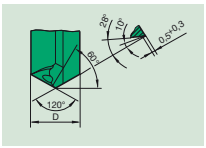
Gun drills must be guided during spot-drilling.
Gun drills must never operate at full speed without support in the machine shop..

- Production of pilot hole (L = 1.5 x D / Alu L ≈ 3 x D, tolerance H8)
- Enter at low revolutions, approx. 200 U/rev., feed rate approx. 500 mm/min. Tools from 40 x D enter in reverse.
- 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

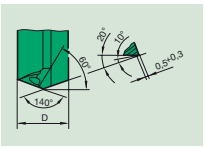
Standard point grinds

Two-fluted gun drills Z80

Ø < 4 mm

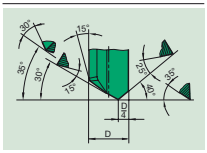


Ø > 4. 01 mm

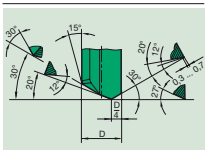


Solid carbide single-fluted gun drills and single-fluted gun drills with carbide head

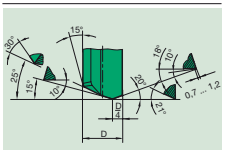
Ø 2…4 mm



Ø > 4…20 mm

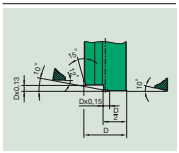


Ø > 20 ... 40 mm

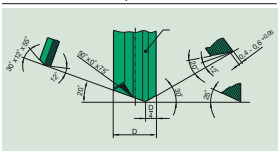


Special ponit grinds
Single-fluted gun drills

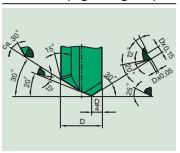
with recessed coolant chamber



with chip breaker



with chip guiding step



Head forms

Special design

Suitable for all materials, but for larger hole tolerances.

Suitable for all materials, but only when spotting conditions are unfavourable.

This design is predominantly suitable for grey cast iron.

Universal design

Suitable for all materials, but for smaller hole tolerances.

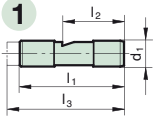
Suitable for difficult-to-machine materials, i.e. high-alloyed steels.

Drivers for single-fluted gun drills

HARTNER

Drivers for deep hole drilling machines

1



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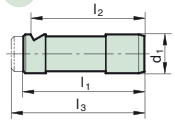

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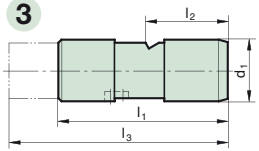

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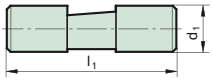

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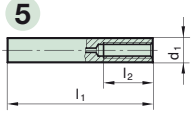
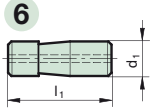
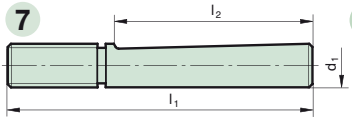


6

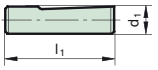


7



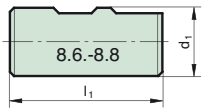
Drivers to DIN 1835

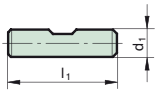
9



Drivers to DIN 6535

8





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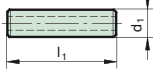
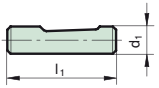
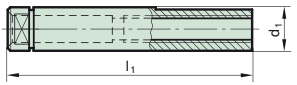


11



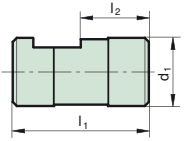
Drivers to design VDI

12



Drivers to speed-bit-system

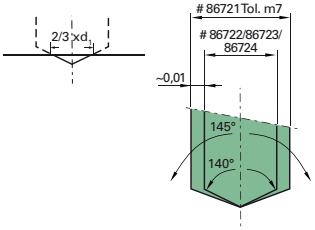
13



Please contact us for detailed information or see our catalogue.

Application recommendations for Multiplex HPC

- for through holes supporting lands must remain in permanent contact.
- don't apply drilling tool without trial for interrupted cutting (grooves, transverse holes). For interrupted cutting (max. 0.2 x D) it is recommended to reduce the feed rate whenever possible.
- in contrast to conventional indexable inserts, Multiplex HPC tools are also suitable for the drilling of stacked sheets.
- on a lathe (stationary tool) it must be ensured that the tool is accurately centred.
- pre-condition for optimal machining results is a sufficient cooling lubricant supply with soluble or neat oil.
- the tool is only of limited suitability for dry machining or MQL. For MQL application we recommend the use of the conical MQL shank end as well as Hartner MQL components. Please contact our Sales Management.



Technical features and application recommendations

● optimal suitability
○ limited suitability

Order no.	86722	86723	86724	86725
Tool material	Solid carbide			
Surface	nanoFIRE	FIRE	bright	nanoA
Point geometry	2-facet	2-facet	relieved cone	relieved cone
Point angle	140°	140°	140°	140°
Tolerance	h7	m7	h7	h7
Drilling depth	11.0-25.5	11.0-25.5	11.0-25.5	11.0-40.0
Application	**Steel**	**Cast iron**	**Aluminium**	**Stainless steel**

Application group	Material examples				
					
P	steel, cast steel, stainless steel (ferritic and martensitic)	●	○		○
M	stainless steel and cast steel (austenitic and austenitic/ferritic)	○			●
K	grey cast iron, spheroidal graphite and malleable cast iron	○	●		
N	aluminium and other non-ferrous metals			●	
S	Special, Super- and Ti-alloys				○
H	Hardened steels and chilled cast iron				○

Technical features and application recommendations

● optimal suitability
○ limited suitability

Order no.	86728	86726	86727
Tool material	Solid carbide		
Surface	TiN	TiAlN	bright
Type	CPGT ... R	CPGW ... R	CPGT ... R
Application	**Steel**	**Cast iron**	**Aluminium**

Application group	Material examples			
				
P	steel, cast steel, stainless steel (ferritic and martensitic)	●	○	
M	stainless steel and cast steel (austenitic and austenitic/ferritic)	○		
K	grey cast iron, spheroidal graphite and malleable cast iron	○	●	
N	aluminium and other non-ferrous metals			●
S	Special, Super- and Ti-alloys	○		
H	Hardened steels and chilled cast iron	○		

Tool holders for drilling depths ≤1×D for pilot drilling/countersinking

Drill-Ø mm	Feed column no.								
	1	2	3	4	5	6	7	8	9
	f (mm/rev.)								
10.00	0.080	0.100	0.125	0.160	0.200	0.250	0.315	0.400	0.400
12.50	0.080	0.100	0.125	0.160	0.200	0.250	0.315	0.400	0.500
16.00	0.100	0.125	0.160	0.200	0.250	0.315	0.400	0.500	0.630
20.00	0.125	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.630
25.00	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.800	0.800
31.50	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.800	1.000
40.00	0.200	0.250	0.315	0.400	0.500	0.630	0.800	1.000	1.250

Order no. 86681

Order no.	**86721**	**86722**	**86725**	**86723**	**86724**
Tool material	**Solid carb.**	**Sol. carb.**	**Sol. carb.**	**Sol. carb.**	**Solid carb.**
Carbide grade	K/P	K/P	K/P	K/P	K/P
Surface	nanoA	nanoFIRE	nanoA	FIRE	bright
Application	**pilot drill./ countersink.**	**Steel**	**Stainless steel**	**Cast iron**	**Al/Al alloys**





v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
130	**6**	*130*	**6**						
110	**5**	*110*	**5**						
130	**7**	*130*	**7**						
110	**6**	*110*	**6**						
130	**6**	*130*	**6**						
125	**6**	*125*	**6**						
110	**5**	*110*	**5**						
110	**6**	*110*	**6**						
90	**5**	*90*	**5**						
130	**7**	*130*	**7**						
110	**6**	*110*	**6**						
70	**4**	*70*	**4**						
105	**5**	*105*	**5**						
70	**4**	*70*	**4**						
60	**5**	*60*	**5**						
55	**4**	*55*	**4**						
55	**3**	*55*	**3**						
50	**2**	*50*	**2**						
55	**3**			*55*	**3**				
40	**3**			*40*	**3**				
35	**3**			*35*	**3**				
25	**2**			*25*	**2**				
25	**2**			*25*	**2**				
100	**6**					*100*	**6**		
90	**6**					*90*	**6**		
120	**7**					*120*	**7**		
100	**6**					*100*	**6**		
90	**6**			*90*	**6**				
40	**3**			*40*	**3**				
35	**2**			*35*	**2**				
200	**7**							*200*	**7**
180	**7**							*180*	**7**
150	**7**							*150*	**7**
120	**7**							*120*	**7**
180	**7**							*180*	**7**
70	**6**							*70*	**6**
180	**7**							*180*	**7**
120	**6**							*120*	**6**
70	**6**							*70*	**6**
50	**6**							*50*	**6**
45	**6**							*45*	**6**
35	**5**							*35*	**5**
80	**5**					*80*	**5**		
80	**5**					*80*	**5**		
80	**5**					*80*	**5**		
80	**5**					*80*	**5**		

Tool holders for drilling depths ≤1.5 / 3 / 5×D

Drill-Ø mm	Feed column no.								
	1	2	3	4	5	6	7	8	9
	f (mm/rev.)								
10.00	0.080	0.100	0.125	0.160	0.200	0.250	0.315	0.400	0.400
12.50	0.080	0.100	0.125	0.160	0.200	0.250	0.315	0.400	0.500
16.00	0.100	0.125	0.160	0.200	0.250	0.315	0.400	0.500	0.630
20.00	0.125	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.630
25.00	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.800	0.800
31.50	0.160	0.200	0.250	0.315	0.400	0.500	0.630	0.800	1.000
40.00	0.200	0.250	0.315	0.400	0.500	0.630	0.800	1.000	1.250

Order no. 86682

Order no. 86683

Order no. 86684

Order no.	**86722**	**86725**	**86723**	**86724**
Tool material	**Solid carb.**	**Solid carb.**	**Solid carb.**	**Solid carb.**
Carbide grade	K/P	K/P	K/P	K/P
Surface	nanoA	nanoFIRE	nanoA	FIRE
Application	**Steel**	**Stainless steel**	**Cast iron**	**Al/Al alloys**




≤1,5/ ≤3xD	≤5xD	Feed col. no.	≤1,5/ ≤3xD	≤5xD	Feed col. no.	≤1,5/ ≤3xD	≤5xD	Feed col. no.	≤1,5/ ≤3xD	≤5xD	Feed col. no.
v_c m/min			v_c m/min			v_c m/min			v_c m/min		
130	125	**6**									
110	105	**5**									
130	125	**7**									
110	105	**6**									
130	125	**6**									
125	120	**6**									
110	105	**5**									
110	105	**6**									
90	85	**5**									
130	125	**7**									
110	105	**6**									
70	70	**4**									
105	105	**5**									
70	70	**4**									
60	55	**5**									
55	50	**4**									
55	55	**3**									
50	50	**2**									
			55	55	**3**						
			40	40	**3**						
			35	35	**3**						
			25	25	**2**						
			25	25	**2**						
						100	100	**6**			
						90	90	**6**			
						120	120	**7**			
						100	100	**6**			
			90	90	**6**						
			40	40	**3**						
			35	35	**2**						
									200	180	**7**
									180	180	**7**
									150	140	**7**
									120	110	**7**
									180	180	**7**
									70	70	**6**
									180	180	**7**
									120	120	**6**
									70	70	**6**
									50	50	**6**
									45	45	**6**
									35	35	**5**
						80	80	**5**			
						80	80	**5**			
						80	80	**5**			
						80	80	**5**			

Tool holders for drilling depths ≤7 / 10×D

Order no. 86685

Order no. 86686

Order no.	86722	86725	86723	86724
Tool material	Solid carb.	Solid carb.	Solid carb.	Solid carb.
Carbide grade	K/P	K/P	K/P	K/P
Surface	nanoA	nanoFIRE	nanoA	FIRE
Application	Steel	Stainless steel	Cast iron	Al/Al alloys




≤7xD	≤10xD	Feed col. no.	≤7xD	≤10xD	Feed col. no.	≤7xD	≤10xD	Feed col. no.	≤7xD	≤10xD	Feed col. no.
v_c m/min			v_c m/min			v_c m/min			v_c m/min		
120	100	5									
105	95	4									
120	100	6									
105	95	5									
120	100	5									
110	95	5									
100	90	4									
100	90	5									
85	85	4									
120	100	6									
100	90	5									
70	70	4									
105	95	4									
70	70	3									
55	55	4									
50	50	3									
55	55	2									
50	50	2									
			55	55	2						
			40	40	2						
			35	35	2						
			25	25	1						
			25	25	1						
						80	80	6			
						70	70	6			
						100	100	7			
						80	80	6			
			70	70	6						
			40	40	2						
			35	35	1						
									180	150	6
									180	150	6
									140	130	6
									110	105	6
									180	150	6
									70	70	5
									180	150	6
									120	110	5
									70	70	5
									50	50	5
									45	45	5
									35	35	4
						60	60	5			
						60	60	5			
						60	60	5			
						60	60	5			

Drilling system Multiplex

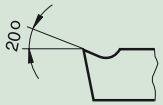
Drill- Ø mm	Feed column no. HSS-E-/ Carbide interchangeable inserts					
	1	2	3	4	5	6
	f(mm/rev.)					
10.00	0.08	0.09	0.11	0.14	0.19	0.24
12.50	0.09	0.11	0.13	0.17	0.22	0.28
16.00	0.11	0.13	0.16	0.21	0.27	0.34
20.00	0.13	0.15	0.19	0.25	0.32	0.40
25.00	0.16	0.18	0.23	0.29	0.38	0.48
31.50	0.19	0.22	0.27	0.35	0.45	0.57
40.00	0.23	0.26	0.33	0.42	0.54	0.69
50.00	0.27	0.31	0.39	0.50	0.64	0.82
63.00	0.32	0.38	0.47	0.60	0.77	0.98
102.00	0.40	0.48	0.59	0.74	0.85	1.20
150.00	0.59	0.70	0.87	1.09	1.25	1.76
200.00	0.78	0.93	1.16	1.45	1.67	2.35

Order no. R	**86602**	**86608**	**86609**
Ø-range	10…25	10…25	25…210
Tool material	**HSS-E-PM**	**HSS-E-PM**	**HSS-E-PM**
Carbide sort	–	–	–
Carbide grade	–	–	–
Surface	T	F	A



v_c m/min	Feed col. no.	v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
40	**4**	48	**4**	48	**4**
35	**4**	42	**4**	42	**4**
50	**5**	60	**5**	60	**5**
40	**5**	50	**5**	50	**5**
40	**4**	45	**4**	45	**4**
35	**4**	40	**4**	40	**4**
30	**4**	35	**4**	35	**4**
25	**3**	28	**3**	28	**3**
22	**2**	25	**2**	25	**2**
35	**3**	40	**3**	40	**3**
25	**3**	28	**3**	28	**3**
22	**2**	25	**2**	25	**2**
22	**3**	25	**3**	25	**3**
15	**2**	18	**2**	18	**2**
26	**3**	28	**3**	28	**3**
22	**2**	25	**2**	25	**2**
12	**2**	18	**2**	18	**2**
10	**2**	13	**2**	13	**2**
20	**2**	23	**2**	23	**2**
15	2	17	2	17	2
15	2	20	2	20	2
35	**4**	40	**4**	40	**4**
35	**4**	40	**4**	40	**4**
35	**4**	40	**4**	40	**4**
28	**4**	33	**4**	33	**4**
60	**5**	65	**5**	65	**5**
80	**5**	85	**5**	85	**5**
85	**5**	85	**5**	85	**5**
70	**5**	70	**5**	70	**5**
45	**4**	50	**4**	50	**4**
45	**4**	50	**4**	50	**4**
60	**5**	65	**5**	65	**5**
45	**4**	50	**4**	50	**4**
32	**5**	35	**5**	35	**5**
40	**3**	45	**3**	45	**3**
36	**3**	40	**3**	40	**3**
28	**3**	32	**3**	32	**3**
22	**3**	27	**3**	27	**3**

Order no. 86709 / 86701
without lands
for materials with tensile strength up to approx. 600 N/mm²

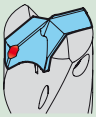
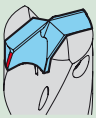
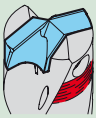


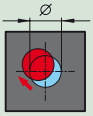
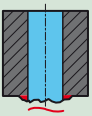
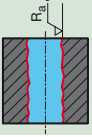
Order no. 86708 / 86702
with lands
for materials with tensile strength over approx. 600 N/mm²

	86708	86709	86701	86702
	10…35	10…35	10…35	10…35
	Solid carbide	Solid carbide	Solid carbide	Solid carbide
	H22	H22	H22	H22
	K20/K40	K20/K40	K20/K40	K20/K40
	T	T	P	P
				

v_c m/min	Feed col. no.	v_c m/min	Feed col. no.
60	5	70	5
55	4	65	4
100	**4**	115	**4**
95	**4**	105	**4**
80	**4**	90	**4**
80	**4**	90	**4**
75	**3**	85	**3**
70	**4**	80	**4**
60	**3**	70	**3**
85	4	95	4
70	**4**	80	**4**
55	**3**	65	**3**
60	**3**	65	**3**
50	**2**	55	**2**
40	**3**	45	**3**
35	**2**	40	**2**
40	**2**	45	**2**
35	**2**	40	**2**
40	**2**	45	**2**
25	2	30	2
25	**1**	30	**1**
100	**5**	120	**5**
90	**4**	105	**4**
80	**4**	90	**4**
65	**3**	75	**3**
25	**1**	30	**1**
180	**5**	200	**5**
160	5	180	5
140	**5**	160	**5**
130	**5**	150	**5**
150	**5**	160	**5**
70	4	80	4
160	**5**	180	**5**
110	4	120	4
80	**5**	90	**5**
65	**4**	75	**4**
45	4	50	4
35	4	40	4
70	**3**	85	**3**
70	**3**	85	**3**
70	**3**	85	**3**
70	**3**	85	**3**

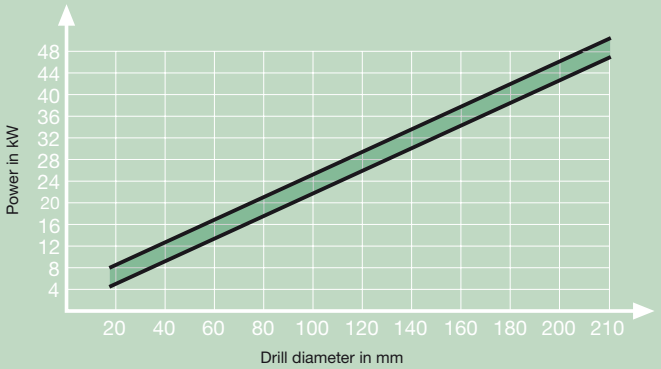
Multiplex HPC
12 tips to help diagnose problems

Problem	Cause	Remedy
1 Cutting edge build up 	low cutting speed	increase cutting speed
	excessive honing of cutting lip	reduce cutting lip honing
	bright finish cutting lip	have tool coated
2 Crumbling of outer corners 	non rigid conditions, insufficient workpiece clamping	rigid clamping of workpiece
	deviation from concentricity too large	check and correct concentricity if possible
	interrupted cut	reduce feed
3 Heavy wear at flank 	cutting speed too high	reduce cutting speed
	feed too low	increase feed
	clearance angle too small	increase clearance angle
4 Crumbling on cutting lips 	non rigid conditions, insufficient workpiece clamping	rigid clamping of workpiece
	interrupted cut	reduce feed
	max. wear values exceeded	reduce tool change intervals
	incorrect tool type	apply suitable tool
5 Land wear 	non rigid conditions, insufficient workpiece clamping	rigid clamping of workpiece
	deviation from concentricity too large	check and correct concentricity if possible
	back taper too small	increase back taper
	incorrect coolant (oil), coolant too weak	increase strength of coolant or use neat oil
6 Scoring on tool body 	non rigid conditions, insufficient workpiece clamping	rigid clamping of workpiece
	deviation from concentricity too large	check and correct concentricity if possible
	interrupted cut	reduce feed
	abrasive workpiece material	increase strength of coolant or use neat oil

Problem	Cause	Remedy
7 **Heavy chisel edge wear** 	cutting speed too low	increase cutting speed
	feed too high	reduce feed
	excessive honing of cutting lip	reduce cutting lip honing
8 **Crumbling at intersection, web thinning and cutting lip** 	clearance angle too small	increase clearance angle
	excessive honing of cutting lip	reduce cutting lip honing
	incorrect tool type	apply suitable tool
9 **Plastic deformation of outer corner** 	cutting speed too high	reduce cutting speed
	insufficient coolant volume	increase volume/pressure
	incorrect or no honing at corner	correct honing
10 **Misalignment** 	non rigid conditions, insufficient workpiece clamping	rigid clamping of workpiece
	deviation from concentricity too large	check and correct concentricity if possible
	spotting area transverse	use milling cutter (2-fluted) for spotting
	chisel edge too large	reduce chisel edge
11 **Heavy burring on break-through** 	feed too high	reduce feed
	max. wear values exceeded	reduce tool change intervals
	excessive honing of cutting lip	reduce cutting lip honing
12 **Unsatisfactory surface quality** 	non rigid conditions, insufficient workpiece clamping	rigid clamping of workpiece
	deviation from concentricity too large	check and correct concentricity if possible
	insufficient coolant volume	increase volume/pressure

General instructions for twist drills with interchangeable inserts system Multiplex

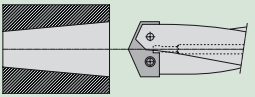
Machine and Workpiece
Only the stability of the machine, spindle, workpiece clamping and the workpiece itself allows the use of tungsten carbide blades. Insufficient rigidity leads to vibrations or „sagging“ of the drill in the case of through holes, when the chisel edge emerges from the workpiece. Short tool life or tool breakage can result.



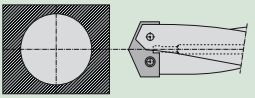
Coolant Equipment
The availability of an efficient coolant equipment is essential. If pressure and quantity are insufficient, this may lead to bad surfaces or even breakages. The size of the solid components should not exceed 50 µm if possible (see diagram page 42/43).

Chip Formation
For general structural steel it is possible that unfavourable chip forms may occur, i.e. long and upset chips. These may obstruct the flutes and can cause the tool to break. This can however be counteracted to some extent by altering the cutting speed and feed. It is necessary to determine this through experiments, due to the fact that the chip formation with general structural steel depends on the range of cutting properties of the various batches. Similar unfavourable chip forms may be produced with corrosion and acid resistant steels.

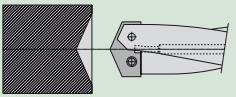
Drilling pre-drilled holes
As the Multiplex system is guided predominantly by the chisel edge, it is not suitable for drilling pre-cast or pre-drilled holes. However, if the system is applied under the aforementioned conditions, the cutting parameters should be reduced.



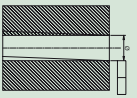
Interrupted cutting
The Multiplex system is not suitable for interrupted cutting (i.e. transverse holes that are larger than the drill diameter).



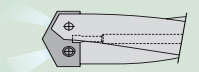
Centering
The inserts for the Multiplex system are web thinned. Therefore, centering is only necessary for larger drilling depths. If centering is necessary for technical reasons, the centering point angle must be equal or larger than the point angle of the insert.
The following applies:
up to d = 25.4 mm = 135°
up to d = 66.0 mm = 132°
from d = 66.0 mm = 140°
A short holder (3xD) may also be applied for centering.



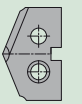
Drill running off center
A drill running off center can be due to several factors. An approximate value of 0.1-0.16 mm for drilling depths up to 7xD is accepted as the norm. In this case the shortest possible and therefore the most rigid holder type should be applied.



Coolant pressure
The coolant used with the Multiplex system is extremely important for the chip evacuation. It can be delivered at a pressure of approx. 5 bar. Generally, the following rule applies. The more coolant available, the better. Through the use of coolant collars or coolant feed chucks, the Multiplex system can also be applied on older machines with existing external cooling. One of our technical engineers will gladly find a solution to your specific application task.

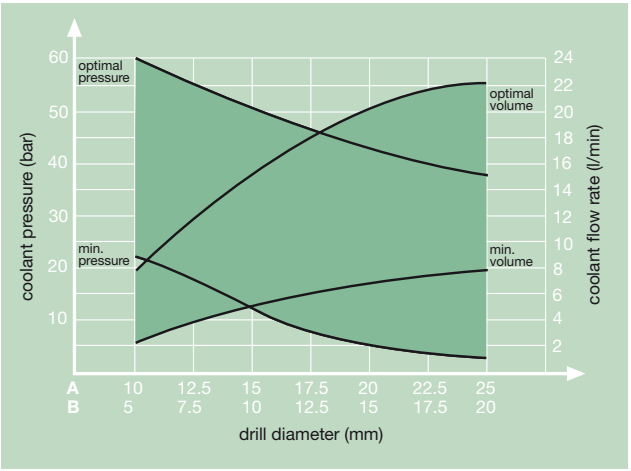


Heavy cutting edge wear
If heat has eroded the corners, the cutting speed is too high and has to be reduced. Measure the unaffected diameter and re-calculate the cutting speed based on this new diameter.
Subtract 10% from resulting speed and enter the value into the machine.



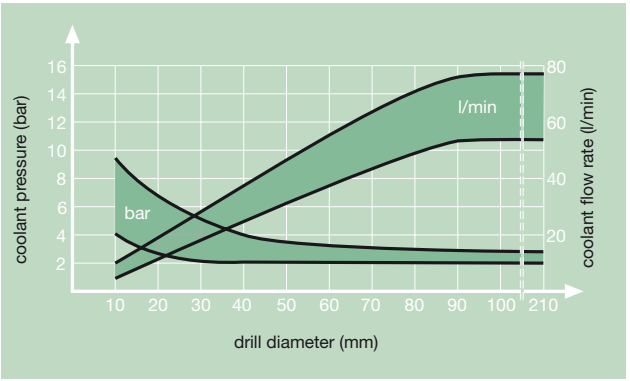
Coolant diagrammes
Coolant pressure and flow rate

for carbide twist drills with internal coolant ducts



A = range of diameters for tools with central internal coolant channel
B = range of diameters for tools with twisted internal coolant feed

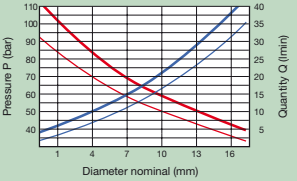
for Multiplex-twist drills with internal coolant ducts



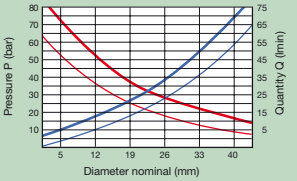
It is absolutely essential here that youuse a high-performance coolant aggregate. If there is insufficient coolant pressure and quantity, the drilling surface may be poor or the tool may even be damaged. If possible, the solid particles in the coolant should not be larger than 50 µm.
Drilling emulsion can be used as a coolant lubricant when drilling with interchangeable blades made of HSS-Co and carbide; it can be used in the usual proportions of 1:20. Important than the composition of the drilling emulsion is the coolant pressure and the amount of coolant. An efficient cooling unit is therefore an important prerequisite for adequate cooling and lubrication.

for gun drills with internal coolant ducts

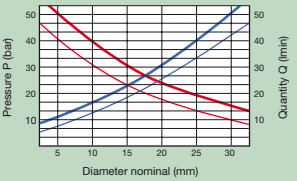
Coolant values E 100
(Recommended values for soluble oil)



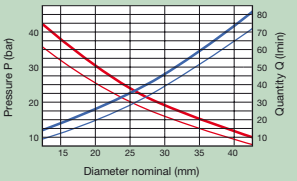
Coolant values E 80
(Recommended values for soluble oil)



Coolant values Z 80
(Recommended values for soluble oil)



Coolant values E 800
(Recommended values for soluble oil)



max. coolant pressure
min. coolant pressure
max. coolant quantity
min. coolant quantity

The tasks of the coolant (KSS)

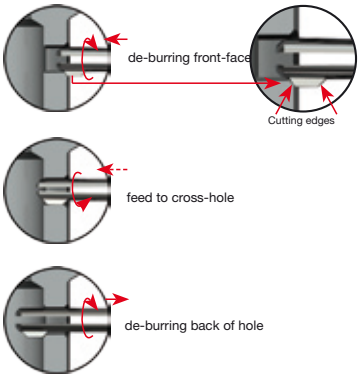
- chip evacuation
  insufficient coolant leads to chip congestion and results in tool breakages.
- lubricating film
  especially with single-fluted gun drills high surface pressure is created between hole and supporting strips. A break in the lubricating film causes excessive friction leading to tool breakages.
- cooling the cutting edges
  during the cutting process, temperatures of approx. 800° C are created at the carbide cutting edge, insufficient cooling drastically reduces tool life.

TS 100 EG de-burring fork

Advantages:

- cost saving. The standard tool offers outstanding price advantages in comparison with special tooling.
- universal tooling for milling, turning and robotic applications. The range of 0.25 mm enables the application of our de-burring fork in holes with large tolerances. Reducing set-up time and cost!
- increased production. De-burring TS 100 EG de-burrs automatically with one set-up and short cycle times. Expensive and extensive manual operations are no longer required.

Operation

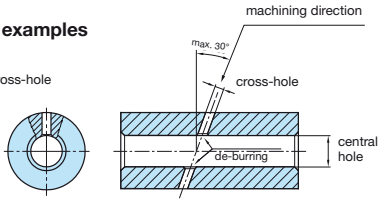


Step by step:

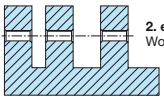
The automatically internal and external de-burring with de-burring forkl TS 100 EG is an easy and cost saving alternative to common, extensive manual operations. Just one tool is required for all machining steps.

Application examples

1. example
Workpiece with cross-hole



Please note when machining workpieces with cross-holes:
- the diameter of the cross-hole must be maximal 35% of the central hole
- the diameter of the cross-hole must be 40% larger than the cutting length l4



2. example
Workpiece with multi-interrupted cut

Universal application:

The new ex-stock de-burring fork machines workpieces with one cross-hole as well as workpieces with multi-interrupted cut and produces high quality de-burred faces and ends of the hole.

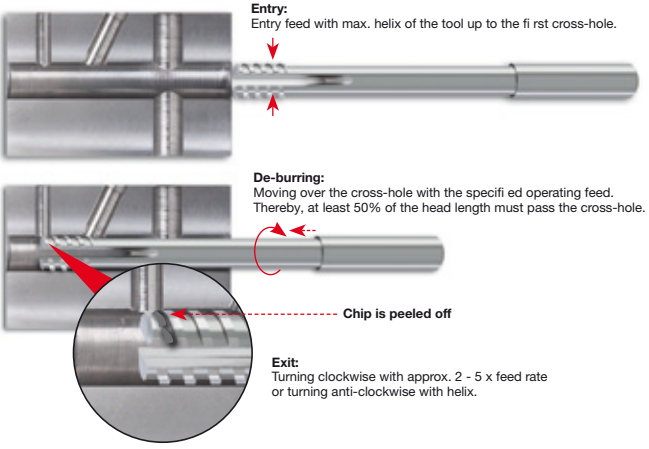
De-burring spiral TS 100 ES
Program semistandard

HARTNER

For internal de-burring of cross-holes through the central hole, Hartner has developed the solid carbide de-burring spiral TS 100 ES. The slotted tool is available as a semistandard tool with immediate effect, i. e. inside the diameter ranges specified in the adjacent table tools can be supplied in one-hundreth increments with the respective shank and length dimensions as well as number of cutting edges with short delivery times and at favourable prices. In addition, at any time other customer specific solutions as special tools, for example, with further reach or other shank diameters.
The principle of function of the de-burring spiral TS 100 ES is based on the pre-tension of the grooved cutting portion. In the area of the cutting portion, the de-burring spiral has a fractionally larger diameter than the bore to be machined.Through the run-on, the grooved cutting portion is pressed together on entry into the hole to be machined and thereby pre-tensioned. The pre-tension ensures that inside the bore and especially in the area of the cross-hole to be de-burred there is a perfect fit of the cutting spiral at the wall of the bore or the edges of the cross-hole respectively. The burr in the cross-hole is subsequently accurately and cleanly peeled off at the root. Thereby very small chips are created that can be evacuated problem-free from the hole.

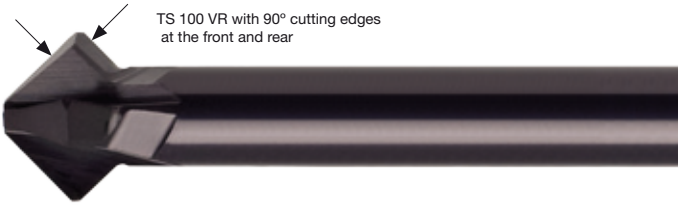
Pre-requisite for the development of the de-burring spiral TS 100 ES was a carbide as tool material that possesses an accordingly low rigidity and permits the necessary deformation in the cutting edge area. Thanks to Hartner‘s carbide expertise in development and production, then a carbide with such special attributes is available.

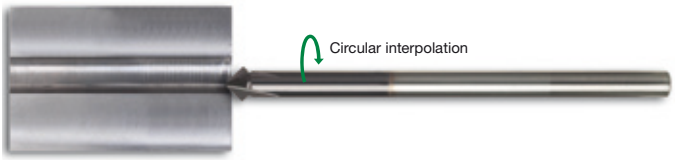
Operation

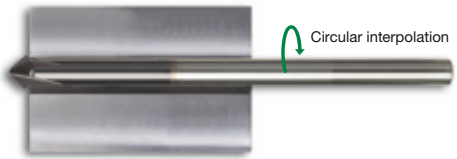


TS 100 VR front/back de-burrer

Hartner‘s solid carbide TS 100 VR front/back de-burrer with TiAlN-coating as a standard tool enables de-burring as well as chamfering of hole entry and exit with a 90° angle.
TS 100 VR possesses a milling head with a front and back cutting region. To de-burr or chamfer the tool performs a circular milling movement along the hole edge or contour.







Cutting parameters de-burring tools

HARTNER

de-burring fork TS 100 EG

Ø-range (mm)	v_c m/min	fu (mm)
< Ø 4	8 - 10	0.1 - 0.2
Ø 4 - < Ø 6	10 - 14	0.1 - 0.2
6 - Ø 8	14 - 20	0.1 - 0.2

de-burring spiral

Ø-range (mm)	v_c m/min	fu (mm)
< Ø 8	15 - 25	0.2 - 0.3
≥ Ø 8	15 - 25	0.4 - 0.8

front/back de-burrer TS 100 VR

Material group	Tens. strength MPa (N/mm²)	Hardness	v_c (m/min)	Feed col. no.
Steels	< 850		*120 - 200*	71
	850-1200		*100 - 180*	71
	> 1200		*80 - 140*	71
Hardened steels		< 54 HRC	*60 - 120*	71
		54-60 HRC	*40 - 80*	71
Stainless/acid-resistant steels	< 850		*80 - 120*	71
Nickel-based alloys	< 1300		*30 - 60*	71
Ti-alloys	< 1300		*50 - 100*	71
Cast materials		< 240 HB30	*120 - 180*	72
		> 240 HB30	*100 - 160*	72
Al wrought alloys < 3% Si			*150 - 250*	72
Al cast alloys > 3% Si			*100 - 200*	72
Magnesium alloys			*150 - 250*	72
Non-ferrous alloys	< 850		*30 - 200*	72

Feed column no. (mm/rev.)

Ø	71	72
≤ 3.00	0.060	0.080
4.00	0.100	0.125
5.00	0.100	0.125
6.30	0.125	0.160
8.00	0.160	0.200
10.00	0.200	0.250
12.50	0.200	0.250

Important:
Please note that the cutting parameters are recommendations. They can be adjusted up or down.

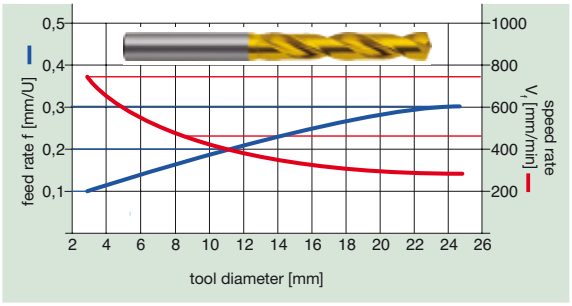
Machine capacitance diagrams

Capacitance of machine

Guidelines for the load capacity of machine with carbide drills type TS 100 can be found in the diagrams on these pages.
In relation to the tool diameter the engineer may use these illustrations to determine the following simply and quickly:
- whether or not his machine spindle will be axially overloaded
- the drive power and
- the required torque.

The minimum values (curves) refer to cutting procedures with a new tool, whereas maximum values refer to a worn tool shortly before the end of its edge life.

The occuring stress is illustrated for steel, cast iron and AlSi-alloys. This shows that the stresses with AlSi7 may be lower, however, the machine must be capable of meeting the required values at relatively high revolutions.



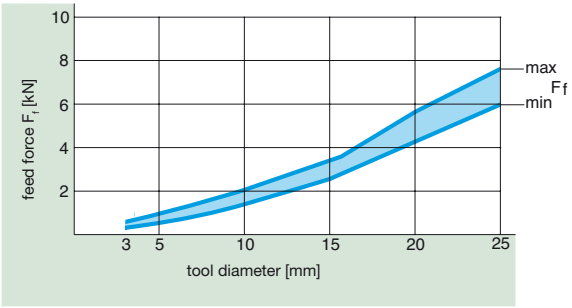
Used tool:

Carbide Drill TS 100

Minimum feed:
for steel: v_C = 70 m/min
for cast iron: v_C = 110 m/min
for AlSi7: v_C = 200 m/min

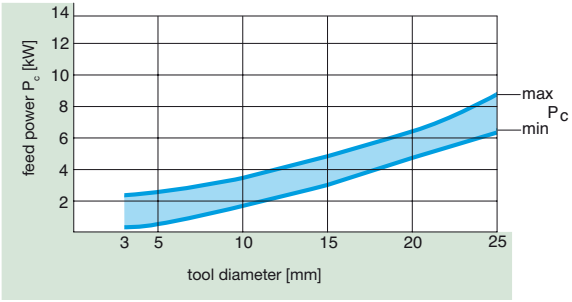
drilling steel (1000 N/mm²)

Feed force



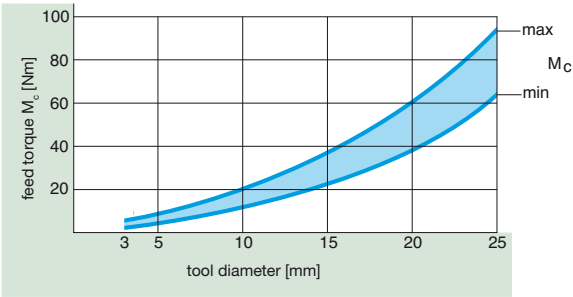
F_f is to be converted linearly for tensile strengths other than 1000 N/mm²

Required power



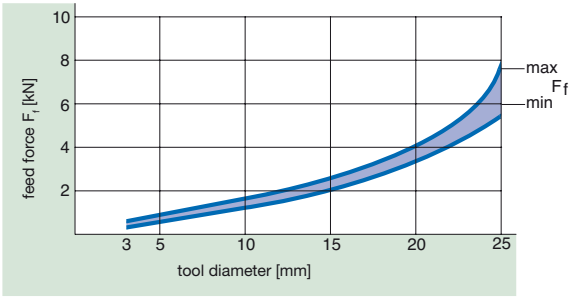
P_c is to be converted linearly for tensile strengths other than 1000 N/mm²

Required torque



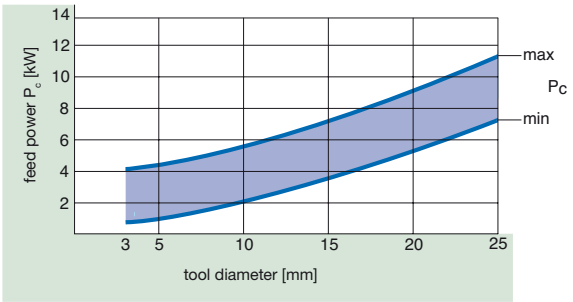
M_c is to be converted linearly for tensile strengths other than 1000 N/mm²

Feed force



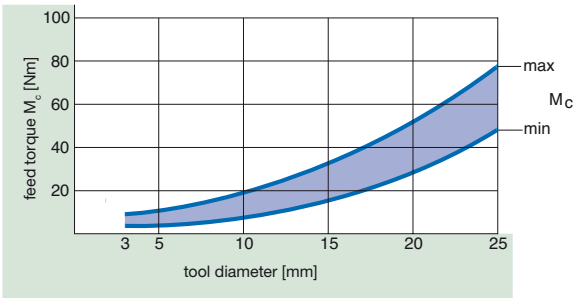
F_f is to be converted linearly for tensile strengths other than 1000 N/mm²

Required power



P_C is to be converted linearly for tensile strengths other than 1000 N/mm²

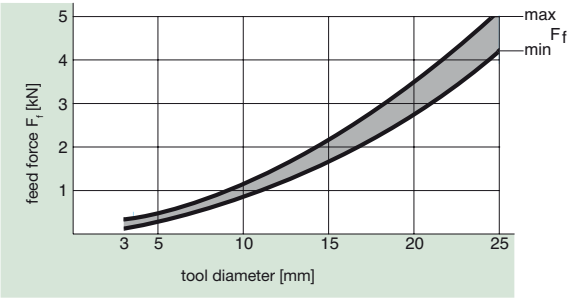
Required torque



M_C is to be converted linearly for tensile strengths other than 1000 N/mm²

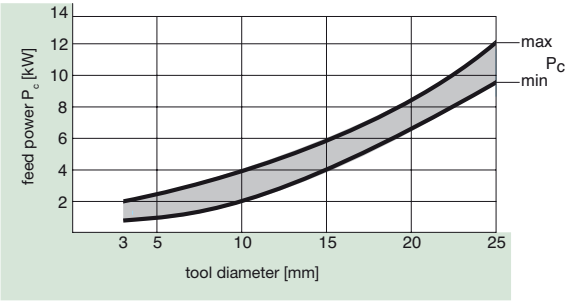
drilling al-alloys (AlSi7)

Feed force



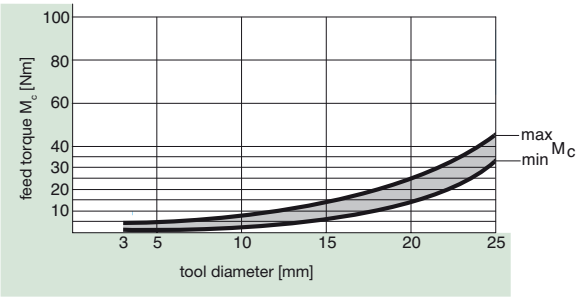
F_f is to be converted linearly for tensile strengths other than 1000 N/mm²

Required power



P_c is to be converted linearly for tensile strengths other than 1000 N/mm²

Required torque



M_c is to be converted linearly for tensile strengths other than 1000 N/mm²

Coatings and surface finishes

Due to their basically good properties, high speed steel and carbide tools are supplied without being surface treated, i.e. in bright finish. For special applications it is desirable to increase the durability and to reduce the sliding resistance and tendency of cold welding by special surface refining process.

Further surface treatments

The following surface treatments loose more and more in significance. Generally much better results you get with hard- or softcoated tools.

1. Nitriding
Nitriding is a further means of increasing the durability of tools. This finish is recommended for the machining of grey cast iron, aluminium with a high silicon content, plastics, steels with a high perlite content etc.

2. Hard-chromium plating
Tools that are treated in such a way especially reduce the sliding resistance and thus the cutting forces. These advantages will however be lost if, during the machine process, the temperature of 250°C is exceeded.

3. Steam tempering
Steam tempered tools also offer a reduction in sliding resistance. Thus cold welding which occurs for example during the machining of steels that have a low carbon content, can be avoided most economically. Steam tempered tools are only suitable for ferrous materials.

4. Burnishing
Burnishing is achieved in liquid solutions at temperatures above or close to 100°C. The solution contains oxidising substances such as nitrite, nitrate and/or colour dyes (i.e. phosphates). The low operating temperatures do not impair the tensile strength of steels which have a low resistance to tempering.

Variants of coatings

When coating our tools we differentiate between
hard coatings: TiN (T-coat), TiAlN (A-coat), AlTiN (Super A-coat), TiCN (C-coat), FIRE (F-coat), and **soft** coatings: MolyGlide® (M-coat).
Each coating offers very interesting advantages for certain applications.

T-coat or TiN-coat (Titanium nitride)
Physical appearance: golden colour
Well proven, cost efficient all-round coat. Generally achieving performance increases of 400% on average. Surpassed in certain cases only by A- and C-coats.

A-coat or TiAlN-coat (Titanium aluminium nitride)
Physical appearance: black-violet colour
A special coat for machining abrasive materials (cast iron, AlSi) and/or working at high temperatures, i.e. in applications without coolant or with limited coolant facilities, such as deep or small diamter holes. Of importance is that the A-coat only achieves performance increases at higher machining rates.

SuperA-coat or AlTiN-coat (Aluminium titanium nitride)
nanoA-coat or AlTiN-coat (Aluminium titanium nitride)
Physical appearance: violet colour
The well established A coating has been developed in our company. By optimizing the structural, chemical and mechanical properties of the new Super-A coating, an extremely high hot hardness, very good oxidation resistance and excellent coating adhesion have been achieved. This coating is used exclusively on carbide cutting tools and is ideally suited for difficult-to-machine materials such as titanium alloys, Inconel as well as machining hardened steel materials (>52HRC) and HSC applications.

C-coat or TiCN-coat (Titanium carbon nitride)
Physical appearance: grey-violet colour
Multi-layered coat with laminar structure. Brings obvious advantages in steel machining operations, in difficult-to-machine materials or whenever demands as to hardness and toughness are above averages.

F-coat or FIRE-coat/nanoFIRE-coat
Physical appearance: red-violet colour
Multi-layered TiAlN-coating. Allround coating, combines the advantages of TiN-, TiAlN- and TiCN-coatings. Excellent „fire-resistant“heat resistance. Considerably better than TiN. High toughness.

Y-coat or TiAlSiN-coat
Physical appearance: bronze colour This multilayer, ultra hard and heat-resistant coating is especially designated for the machining of high-tensile steels as well as hardened steels and cast iron.

M-coat or MolyGlide®-coat based on MoS_2
Physical appearance: dark-olive colour
Patented soft coating, a glide coating especially developed to improve chip transportation and eliminate built-up edge when machining Al alloys. Combined with the A-coat, tool life on average can be doubled. But also dry HSC machining of steel can be achieved with the M-coat.

Coatings

Short description

	T TiN-coat	A TiAlN-coat	A a AlTiN-coat
Process	PVD	PVD	PVD
Coating temperature max. (°C)	450...500°	350°	450°
Substrate	HSS, carbide, cermet	HSS, carbide, cermet	HSS, carbide, cermet
Structure	mono	mono	mono
Layers (sub-layer)	1	1	1
Colour	golden	black violet	violet
Thickness (µm)	application orientated	application orientated	application orientated
Hardeness (HV 0,05)	2300	3200	3400
Heat transfer (kW/mK)	0.07	0.05	0.05
Application temperature max.(°C)	< 600	< 800	< 900
Type of machining	universal	drilling, turning	universal
Preferred machineable	universal	cast iron, GGG, AlSi	difficult-to-machine materials like Ti-alloys, CGI, Inconel and hardened steels
Materials characteristics	cost effective	dry machining	Hard machining (>52 HRC) high speed cutting

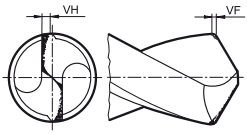
C TiCN-coat	F FIRE-coat	Y TiAlSin-coat	M MolyGlide-coat
PVD	PVD	PVD	PVD
450...500°	450...500°	450...500°	150°
HSS, carbide, cermet	HSS, carbide, cermet	HSS, carbide, cermet	HSS, carbide, cermet
mono	multi	multi	mono
1	6	nanokomposit	1
grey violet	red violet	bronze red	grey
application orientated	application orientated	application orientated	application orientated
3000	3300	5500	20-50
0.1	0.05	0.03	< 0.1
< 400	< 800	< 800	< 800
drilling, milling, thread cutting	universal	drilling, milling	drilling, milling, thread cutting, reaming
steel, for high tensile strength materials, Inconel, Monel	universal	cast iron, hardened steels, high tensile steels CFK	Al, AlSi, steel, special alloys
dry machining, MQL, interrupted cutting	dry machining, MQL	extremely hard layer (5500 Hv)	dry machining, MQL

Typical drilling problems

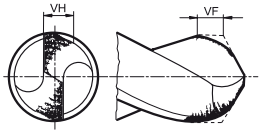
Problem	Cause	Remedy
1. Drill splits	Axial backlash of drill spindle. Workpiece not properly clamped (spring action). Excessive Feed.	Remove dead travel in spindle. Clamp workpiece. securely. reduce feed.
2. Drill breaks	Drill badly located in chuck. Poor removal off swarf from hole. Drill feed into material past the drill run-out. worn or badly ground drill.	Tighten drill in chuck. Remove swarf from flutes more frequently. Select longer drill. Do not use drill past its run-out. Regrind drill correctly and in good time.
3. Drill snatches and breaks	Porousity in workpiece; drill angeled when removed from workpiece.	Clamp workpiece securely. Take care when drilling by hand.
4. Lands are worn	Excessive speed, poor cooling.	Reduce speed, increase coolant flow.
5. Drill blunts quickly	Excessive speed, poor cooling.	Regrind drill, reduce speed increase coolant flow.
6. Excessive torque causes drilling machine to jerk, drill jumps out and breaks	Excessive feed pressure, machine power too low.	Reduce feed, do not overload machine.
7. Small diameter drill breaks	Drill projects too far out of chuck.	If possible use a drill bush, otherwise only allow half the length of the drill to project from the chuck drill halfway, reposition drill and drill to depth.
8. Score marks on straight shank of drill 	Drill not clamped tight enough, allowing it to slip. Drill overloaded by excessive feed. Drill flutes clogged by swarf causing excessive friction.	Tighten drill in the chuck and insert at sufficient depth. Reduce feed. Remove swarf frequently from clogged flutes..
9. Tang breaks off or is damaged 	Drive taper was greasy or contaminated or burred so that tang had to bear the full torque. Damage can also occur if drill is forcefully removed.	Remove grease and dirt from taper before insertion. Remove burr. Only remove drill spindle manually by means of a drift or ejector tool.

Problem	Cause	Remedy
to 9. (cont.)	Core drilling of pre-drilled or pre-cast holes: the drill hooks in, is pulled out of the taper and the tang shears off	Web thinned chisel edge with modified lip acc. to DIN 1412 B (to reduce the rake angle).
10. Drill tip shows coloured farnishing	Overheating of drill point caused by excessive cutting speed or insufficient cooling. Excessive feed when deep drilling	Reduce cutting speed (rpm). Ensure sufficient cooling. Reduce feed with drilling.
11. Hole is larger than drill nominal diameter	Drill is badly ground and lips are of different length.	Regrind drill corretly using a gauge or mount on a special machine (preferred).
12. Hole shows scoring and has burrs 	Drill is blunt. Burrs at exit may be caused by absence of support when drilling and excessive feedwhen drilling through holes.	Only use sharp, ground drills and suitable backing supports. Reduce when drilling through holes.
13. Hole walls are very rough	Drill was blunt, feed was excessive or lubrication insufficient.	Regrind drill, reduce feed, supply suitable lubricant quantities
14. Hole is slanted	Workpiece was mounted at an angle or failed to lie flat because the support was not flat there where cuttings under the workpiece, the support or under the vice.	Place workpiece in vice at same height or on top of a flat support. Remove cuttings from drilling table.
15. Hole is out-ofround, slanted and off-centre	Excessive feed. The workpiece therefore became bent to mirror the bow of the drill or machine. Drill point not on hole centre. Drill vibrating.	Reduce feed. Align drill point. Ensure drill runs true.
16. Drilling machine runs more quiet when drill is removed than when drilling	Drill is vibrating or workpiece is badly aligned with drill point when spot drilling.	Insert drill so that it runs straight and align workpiece to the drill point before spot drilling.

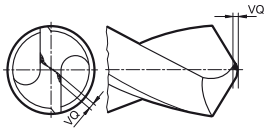
Types of wear



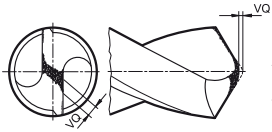
Normal wear on lips (flank wear) and normal chisel edge wear. When regrinding, shorten the drill point until wear marks are removed from lands.



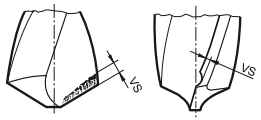
Excessive blunting of lips indicates excessive cutting speed. Tool life is drastically reduced. If this drill is further used for drilling, the cutting edges will glow and the material will weld to the drill.



The deformed chisel edges indicate drilling with excessive feed. A high feed only produces good tool life if the swarf can flow smoothly and unhindered along the flutes.



Premature blunting of chisel edges indicates drilling with an excessive feed. After severe deformation of the chisel edge, the lips will also become blunt if the drill is used without resharpening



If crater wear occurs after using the drill for a long time, it is an indication of well selected machining conditions. A smooth face reduces crater wear. However, built-up edge occur with a small rake angle. This is caused by insufficient cooling, primarily with soft materials.

VS = face wear (cratering)
VQ = chisel edge wear
VH = lip wear
VF = chamfer and corner wear

Swarf removal frequency when deep hole drilling

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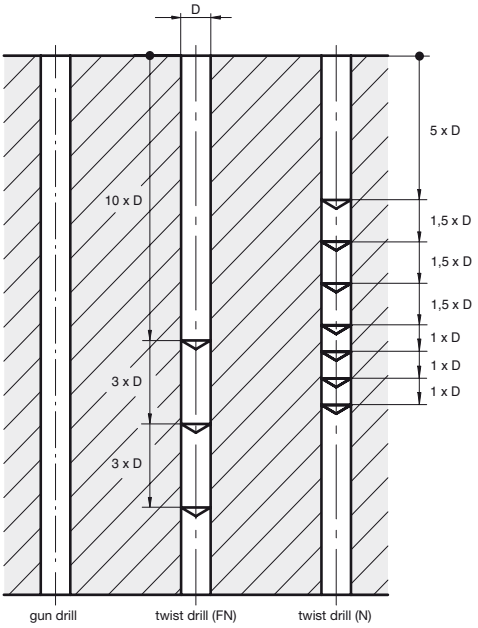
When deep-hole drilling, special care must be taken to supply sufficient coolant to the drill point. The drill point is sufficiently cooled by removing swarf one or several times from the hole. The frequency of swarf removal is mainly dependant on the workpiece material, the drill hole depth an the drill type.

When using deep-hole drills with flat flute sections (FN), there is a marked reduction in swarf removal frequency. With some materials, the swarf shape can be influenced by changing the point angle. The correct chip shape improves both swarf removal and coolant feed. The use of oil-feed drills with internal coolant supply is recommended for extremely deep holes or when drilling horizontally.

The data listed are intended as a guide and represent average values.



Drill standards acc. to DIN

DIN	Type
333	Center drills
338	Straight shank jobber drills
339	Straight shank bushing drills with tang
340	Long series, straight shank drills
341	Taper shank bushing drills
343	Taper shank core drills
344	Straight shank core drills
345	Taper shank drills
346	Oversize taper shank drills
1864	Taper shank core drills, 3-fluted
1869	Extra length straight shank drills
1870	Extra length taper shank drills
1897	Stub drills
1898	Taper pin drills,
	A = with straight shank,
	B = with taper shank
1899	Microdrills
6537	Carbide drills with stepped parallel shank
6540	Technical terms for solid carbide drills
8374	90° Straight shank subland drills
8375	90° Taper shank subland drills
8376	180° Straight shank subland drills
8377	180° Taper shank subland drills
8378	90° Straight shank subland drills
	for tapping size holes
8379	90° Taper shank subland drills
	for tapping size holes

Twist drills definitions acc. to DIN ISO 5419

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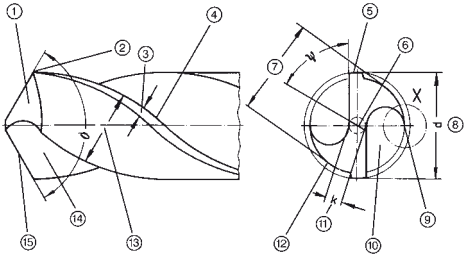
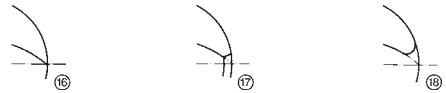
Body



σ = point angle (Sigma)
ψ = chisel edge angle (Psi)

detail x

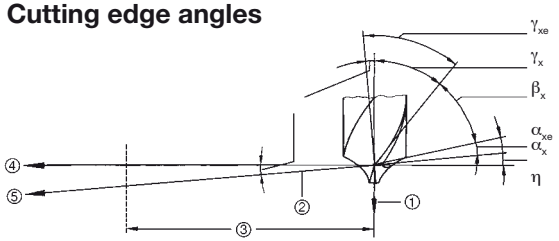


designations:

1 = flank
2 = outer corner
3 = land width
4 = secondary cutting edge
5 = land
6 = chisel edge
7 = body clearance diameter
8 = drill diameter
9 = heel
10 = flute
11 = web thickness
12 = body clearance
13 = front flank width
14 = face
15 = lip
16 = heel deburred
17 = heel chamfered
18 = heel rounded

For machining purposes, the land width b is that of the flank and is represented by $bf_{\alpha n}$ see DIN 6518

Cutting edge angles



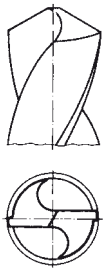
designation:

1 = feed direction
2 = feed f
3 = dist. travelled by outer corner p. revolution (d · p)
4 = direction of cut
5 = direction of approach

α_x	lip clearance angle (Alpha)
γ_x	rake angle (Gamma)
α_{xe}	eff. lip clearance angle
γ_{xe}	eff. rake angle
β_x	wedge angel (Beta)
η	eff. angle of travel of outer corner (eta)

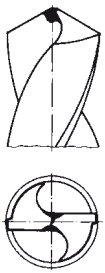
Lip clearance angle α, wedge angle β and rake angle γ are measured in the wedge measuring plane. For details, see DIN 6581, definitions of machining technology; geometry of the tool cutting wedge.

Point geometry



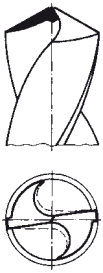
Relieved Cone, Standard Point Design

Application: For all routined drilling operations in steel, non-ferrous metals and plastics. The point angle depends on the machinability of the materials.
Advantages: Strong lips, resistant to impact and lateral forces. Regrinding is simple and may be carried out by hand.
Disadvantages: Wide chisel edge requires high feed pressure.



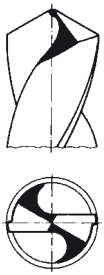
Web-thinned Chisel-Edge according to DIN 1412 A

Application: For all routine drilling operations with thick webbed drills, and for drilling into solid material with large diameter drills.
Advantages: Good centering for spot drilling due to reduction of chisel edge length to 1/10 of drill diameter and reduction in feed pressure
Disadvantages: Greater outlay for regrinding.



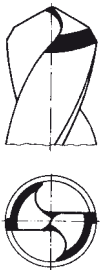
Web-thinned Chisel-Edge with modified lip according to DIN 1412 B

Application: For high-strength steels, manganese steels containing more than 10% Mn, hard spring steels and for enlarging existing holes.
Advantages: Resistant to impact, one sided-loading and lateral forces. No snatching on thin-walled workpieces.
Disadvantages: High feed pressure, tendency to more off-centre, greater outlay for regrinding.

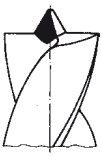


Split Point according to DIN 1412 C

Application: For drills with very thick webs, destined for very tough, hard materials and deep-hole drills.
Advantages: Good centering, low feed. Improved chip removal by means of chip breaker.
Disadvantages: Correct regrinding only possible by machine.



Double angle-Point for Grey Cast Iron according to DIN 1412 D
Application: For drilling workpieces made from grey and malleable cast iron and forgings.
Advantages: Protects outer corners due to increased lip length, resistant to impact, good heat conducting properties.
Disadvantages: Greater outlay for regrinding.



Centre Point according to DIN 1412 E
Application: For drilling sheet metal and soft materials, for flat bottomed blind holes.
Advantages: Good centering, reduced burrs on though holes, precise drilling in thin sheet and pipes no snathing. Available ≥ 2.5 Ø.
Disadvantages: Sensitive to impact and one-sided loading. Correct regrinding only possible by machine.

Relieved Cone with Secondary Flank and Web Thinned Chisel edge*
Application: For drills with stable profile suitable for automatic operation, narrow flutes with strong web.
Advantages: Very good self-centering properties when using high cutting feeds and speeds. Concave cutting edges produce short chips.
Disadvantages: Greater outlay for regrinding.

*especially with solid carbide TS drills

Twist drill definition, design, application

Twist Drill Definition (HSS und Carbide)

Diameter range	Application
N	for normal machining materials (e.g. steel, cast steel, grey casting)
H	for hard, short chipping materials (e.g. brass, bronze, elektron metal)
W	for soft, long-chipping materials (e.g. Al-alloys, copper)
FN	for normal machining materials with extra deep holes
FN 500	for long chipping tough materials (e.g. high-alloyed steels, heat treatable and case hardened steels)
FU 500	for universal applications (e.g. alloyed and unalloyed steels up to 800 mm^2)
FW	for soft, long-chipping materials with extra deep holes
EN	for short-chipping materials up to approx. 1200 N/mm^2
S	for tough difficult-to-machine materials (e.g. stainless and heat-resistant steels)
IS	for tough, stainless acid and heat-resistant steels
V	for tough, difficult-to-machine materials (e.g. spring steels)
TS 3	for the production of holes with high positional and dimensional accuracy
TS 80 U	for universal applications (e.g. GG, GGG, steel up to approx. 1000 N/mm^2)
TS 100 F	for long chipping, tough materials up to approx. 1400 N/mm^2 (e.g. heat treatable steels, high alloyed steels)
TS 100 U	for steels up to approx. 1000 N/mm^2, universal applications
TS 150 GG	for short chipping cast materials, aluminium and Al alloys with high Si content
TS 100 R	for new cast materials GGV and ADI, cast iron, spheroidal graphite iron and malleable cast iron
TS 100 T	for deep drilling in steel and cast iron
TS 100 INOX	for stainless steels
TS 100 H	for high-strength steels and hardened and special alloys

Rake-angle	Point-angle	Point grind	
20°-30°	118°	relieved cone, standard point grind	high speed cutting drills
12°-16°	118°	relieved cone, standard point grind	
35°-40°	130°	relieved cone, standard point grind	
35°	130°	relieved cone, web-thinned chisel edge	
20° - 30°	130°	relieved cone, standard point grind	
35°	118°	2-facet cone, special point grind	
35°-40°	130°	relieved cone, standard point grind	
20° - 30°	130°	relieved cone, with web-thinned form A	
35°	130°	relieved cone, standard point grind	
40°	130°	relieved cone, standard point grind	
20°-30°	130°	relieved cone, web-thinned chisel edge	
28°	150°	facet grinding	carbide drills
20°-30°	140°	relieved cone, with web-thinned form U	
20°-30°	140°	relieved cone, with web-thinned form F	
25°-35°	140°	relieved cone, with web-thinned form U	
0° (straight fluted))	120°	relieved cone, with web-thinned form GG	
30°	–	radius grinding	
30°	135°	relieved cone	
30°	140°	facet grinding	
30°	140°	facet grinding	

Tool materials

High speed steels

Short description	Steel description	Material no.	comparable international steels		
			USA	France	Italy
HSS	S-6-5-2 (DMO5)	1.3343	M 2	Z 90 WDCV 06-05-04-02	HS 6-5-2
HSCO HSS-E	S-6-5-2-5 (EMO5CO5)	1.3243	M 35	Z 90 WDKCV 06-05-05-04-02	HS 6-5-2-5
HSS-E	S-6-5-3 (EMO5V3)	1.3344	M 3	Z 120 WDCV 06-05-04-03	HS 6-5-3
M42 HSS-E	S-2-10-1-8	1.3247	M 42	Z 110 DKCWV 09-08-04-02-01	HS 2-9-1-8
HSS-E-PM	S-6-5-3-9 ASP 30	-	-	-	-

Carbide

Article	Tool material and coating		ISO-group
Multiplex drillblade	carbide H22	FIRE, TiN	fine grain K20-K40
Multiplex countersink blade	carbide S3X7		fine grain K
Multiplex countersink blade	carbide GH1		fine grain K20-K30
VHM twist drill	carbide		fine grain K10-K20
TS-Drill F	carbide	FIRE, TiN	fine grain K/P
TS-Drill U	carbide	FIRE, TiN	fine grain K/P
TS-Drill U	carbide	FIRE, TiN	fine grain K/P
TS-Drill U	carbide	FIRE, TiN	fine grain K/P
TS-Drill R	carbide	FIRE	fine grain K/P
TS-150 GG	carbide		fine grain K
TS 100 T	carbide	TiAlN	fine grain K/P
TS 100 INOX	carbide	AlTiN nano	fine grain K/P
TS 100 H	carbide	TiAlSiN	fine grain K/P

GB	Application
BM 2	Standard tool material for most common applications
BM 35	High heat-resistance, especially suited for high cutting temperatures or when coolant insufficient
-	High friction resist. and cutting edge stability, especially important for reaming operations, increased heat-resist. and hardness
BM 42	higher heat resistance and hardness, suitable for difficult-to-machine materials
-	High hardness, heat-resistance and cutting edge stability, very dense, smooth structure

Due to the fact that our new K-carbide grades offer a wider range of applications we just make a distinction between the K carbide group (for uncoated tools) and K/P carbide group (for coated tools).

Application
for grey cast iron, non ferrous materials and plastics, steel and cast steel
for steel and cast steel
for grey cast iron, non ferrous metals and plastics
for grey cast iron, steel materials Al-alloys, duroplastics, CFK, GFK
for long chipping, tough mterials such as Inconell, Hastelloy, Monel, up to approx.1400 N/mm^2
for steels up to approx. 1200 N/mm^2
for grey cast iron, low,- high-alloyed and unalloyed steels, brass, bronze, plastics
for short-chipping materials such as grey cast iron, spheroidal graphite iron, AlSi-cast
for GGV and ADI
for short-chipping materials such as cast iron, grey cast iron, tempered grey cast iron, spheroidal graphite iron
for steel and cast material
for non-ferrous steel
for high-tensile and hardened steels, special alloys

Diameter tolerances

ISO-tolerances

Diameter range mm		Values mm (measured across the lands, across outer corners)				
		h8	h7	h6	h5	m7
from	1.0	0	0	0	0	
up to	3.0	– 0.014	– 0.010	– 0.006	-0.004	
over	3.0	0	0	0	0	0.016
up to	6.0	– 0.018	– 0.012	– 0.008	-0.005	0.004
over	6.0	0	0	0	0	0.021
up to	10.0	– 0.022	– 0.015	– 0.009	-0.006	0.006
over	10.0	0	0	0	0	0.025
up to	18.0	– 0.027	– 0.018	– 0.011	-0.008	0.007
over	18.0	0	0	0	0	0.029
up to	30.0	– 0.033	– 0.021	– 0.013	-0.009	0.008
over	30.0	0	0	0	0	
up to	50.0	– 0.039	– 0.025	– 0.016	-0.011	
over	50.0	0	0	0	0	
up to	80.0	– 0.046	– 0.030	– 0.019	-0.013	
over	80.0	0	0	0	0	
up to	100.0	– 0.054	– 0.035	– 0.022	-0.015	

The standard tolerances for twist drill production to DIN 1414 corresponds with tolerance table h8 of ISO standards. For twist drills with tighter diameter tolerances according to tolerance table h7, h6 and h5, see list of extra charges.

Permissible variations for dimensions without tolerances according to DIN-ISO 2768

Numerical values for lengths (in mm)

Degree of precision	nominal dimension range		
	0.5 up to 3	over 3 up to 6	over 6 up to 30
fine	± 0.05	± 0.05	± 0.1
medium	± 0.1	± 0.1	± 0.2
coarse	± 0.15	± 0.2	± 0.5
very coarse	-	± 0.5	± 1

Numerical values for lengths (in degrees and minutes)

Degree of precision	nominal dimension range		
	up to 10	over 10 up to 50	over 50 up to 120
fine, medium	± 1°	± 30°	± 20°
coarse	± 1°30'	± 1°	± 30°
very coarse	± 3°	± 2°	± 1°

HARTNER

Microdrill tolerances to DIN 1899

The tolerances of microdrill production up to 1.5 mm diameter complies with tolerances acc. to DIN 1899.

Body diameter tolerance	= 0/– 0.004 mm
Shank diameter tolerance h8	= 0/– 0.014 mm

over 30 up to 120	over 120 up to 400	over 400 up to 1000	over 1000 up to 2000	over 2000 up to 4000
± 0.15	± 0.2	± 0.3	± 0.5	-
± 0.3	± 0.5	± 0.8	± 1.2	± 2
± 0.8	± 1.2	± 2	± 3	± 4
± 1.5	± 2.5	± 4	± 6	± 8

over 120 up to 400	over 400
± 10‘	± 0°5‘
± 15‘	± 0°10‘
± 30‘	± 0°20‘

Dimensions of straight shank twist drills

Ø mm over		up to	DIN 1897 total length mm	DIN 1897 flute length mm	DIN 338 total length mm	DIN 338 flute length mm	DIN 339 total length mm	DIN 339 flute length mm
0.19	–	0.24			19	2,5		
0.24	–	0.30			19	3		
0.30	–	0.38			19	4		
0.38	–	0.48			20	5		
0.48	–	0.53	20	3	22	6	28	12
0.53	–	0.60	21	3,5	24	7	32	15
0.60	–	0.67	22	4	26	8	36	18
0.67	–	0.75	23	4,5	28	9	39	20
0.75	–	0.85	24	5	30	10	42	22
0.85	–	0.95	25	5,5	32	11	45	24
0.95	–	1.06	26	6	34	12	48	26
1.06	–	1.18	28	7	36	14	50	28
1.18	–	1.32	30	8	38	16	52	30
1.32	–	1.50	32	9	40	18	55	33
1.50	–	1.70	34	10	43	20	58	35
1.70	–	1.90	36	11	46	22	62	38
1.90	–	2.12	38	12	49	24	66	41
2.12	–	2.36	40	13	53	27	70	44
2.36	–	2.65	43	14	57	30	74	47
2.65	–	3.00	46	16	61	33	79	51
3.00	–	3.35	49	18	65	36	84	55
3.35	–	3.75	52	20	70	39	91	60
3.75	–	4.25	55	22	75	43	96	64
4.25	–	4.75	58	24	80	47	102	69
4.75	–	5.30	62	26	86	52	108	74
5.30	–	6.00	66	28	93	57	116	80
6.00	–	6.70	70	31	101	63	124	86
6.70	–	7.50	74	34	109	69	133	93
7.50	–	8.50	79	37	117	75	142	100
8.50	–	9.50	84	40	125	81	151	107
9.50	–	10.60	89	43	133	87	162	116
10.60	–	11.80	95	47	142	94	173	125
11.80	–	13.20	102	51	151	101	184	134
13.20	–	14.00	107	54	160	108	194	142
14.00	–	15.00	111	56	169	114	202	147
15.00	–	16.00	115	58	178	120	211	153
16.00	–	17.00	119	60	184	125	218	159
17.00	–	18.00	123	62	191	130	226	165
18.00	–	19.00	127	64	198	135	234	171
19.00	–	20.00	131	66	205	140	242	177
20.00	–	21.20	136	68				
21.20	–	22.40	141	70				
22.40	–	23.60	146	72				
23.60	–	25.00	151	75				
25.00	–	26.50	156	78				
26.50	–	28.00	162	81				
28.00	–	30.00	168	84				
30.00	–	31.50	174	87				
31.50	–	33.50	180	90				
33.50	–	35.50	186	93				
35.50	–	37.50	193	96				
37.50	–	40.00	200	100				

DIN 340		DIN 1869		DIN 1869		DIN 1869	
total length mm	flute length mm	total length mm	flute length mm	total length mm	flute length mm	total length mm	flute length mm
		serie 1		serie 2		serie 3	
32	12						
35	15						
38	18						
42	21						
46	25						
51	29						
56	33						
60	37						
65	41						
70	45						
76	50						
80	53						
85	56	125	85				
90	59	135	90				
95	62	140	95				
100	66	150	100	190	130		
106	69	155	105	200	135		
112	73	165	115	210	145	265	180
119	78	175	120	220	150	280	190
126	82	185	125	235	160	295	200
132	87	195	135	245	170	315	210
139	91	205	140	260	180	330	225
148	97	215	150	275	190	350	235
156	102	225	155	290	200	370	250
165	109	240	165	305	210	390	265
175	115	250	175	320	220	410	280
184	121	265	185	340	235	430	295
195	128						
205	134						
214	140						
220	144						
227	149						
235	154						
241	158						
247	162						
254	166						
261	171						
268	176						
275	180						
282	185						

Dimensions of taper shank twist drills

Ø mm over	up to	DIN 345 total length mm	DIN 345 flute length mm	DIN 345 MT	DIN 346 total length mm	DIN 346 flute length mm	DIN 346 MT
2.65	3.00	114	33	1			
3.00	3.35	117	36				
3.35	3.75	120	39	1			
3.75	4.25	124	43	1			
4.25	4.75	128	47				
4.75	5.30	133	52	1			
5.30	6.00	138	57	1			
6.00	6.70	144	63	1			
6.70	7.50	150	69	1			
7.50	8.50	156	75	1			
8.50	9.50	162	81	1			
9.50	10.60	168	87	1	185	87	2
10.60	11.80	175	94	1	192	94	2
11.80	13.20	182	101	1	199	101	2
13.20	14.00	189	108	1	206	108	2
14.00	15.00	212	114	2	235	114	3
15.00	16.00	218	120	2	241	120	3
16.00	17.00	223	125	2	246	125	3
17.00	18.00	228	130	2	251	130	3
18.00	19.00	233	135	2	256	135	3
19.00	20.00	238	140	2	261	140	3
20.00	21.20	243	145	2	266	145	3
21.20	22.40	248	150	2	271	150	3
22.40	23.02	253	155	2	276	155	3
23.02	23.60	276	155	3	276	155	3
23.60	25.00	281	160	3	309	160	4
25.00	26.50	286	165	3	314	165	4
26.50	28.00	291	170	3	319	170	4
28.00	30.00	296	175	3	324	175	4
30.00	31.50	301	180	3	329	180	4
31.50	31.75	306	185	3	334	185	4
31.75	33.50	334	185	4	372	185	5
33.50	35.50	339	190	4	377	190	5
35.50	37.50	344	195	4	382	195	5
37.50	40.00	349	200	4	387	200	5
40.00	42.50	354	205	4	392	205	5
42.50	45.00	359	210	4	397	210	5
45.00	47.50	364	215	4	402	215	5
47.50	50.00	369	220	4	407	220	5
50.00	50.80	374	225	4	412	225	5
50.80	53.00	412	225	5			
53.00	56.00	417	230	5			
56.00	60.00	422	235	5			
60.00	63.00	427	240	5			
63.00	67.00	432	245	5			
67.00	71.00	437	250	5			
71.00	75.00	442	255	5			
75.00	76.20	447	260	5			
76.20	80.00	514	260	6			
80.00	85.00	519	265	6			
85.00	90.00	524	270	6			
90.00	95.00	529	275	6			
95.00	100.00	534	280	6			

DIN 341			DIN 1870			DIN 1870		
total length mm	flute length mm	MT	total length mm	flute length mm	MT	total length mm	flute length mm	MT
			serie 1			serie 2		
145	64	1						
150	69	1						
155	74	1						
161	80	1						
167	86	1						
174	93	1						
181	100	1	265	165	1	330	210	1
188	107	1	275	175	1	345	220	1
197	116	1	285	185	1	360	235	1
206	125	1	300	195	1	375	250	1
215	134	1	310	205	1	395	260	1
223	142	1	325	220	1	410	275	1
245	147	2	340	220	2	425	275	2
251	153	2	355	230	2	445	295	2
257	159	2	355	230	2	445	295	2
263	165	2	370	245	2	465	310	2
269	171	2	370	245	2	465	310	2
275	177	2	385	260	2	490	325	2
282	184	2	385	260	2	490	325	2
289	191	2	405	270	2	515	345	2
296	198	2	405	270	2	515	345	2
319	198	3	425	270	3	535	345	3
327	206	3	440	290	3	555	365	3
335	214	3	440	290	3	555	365	3
343	222	3	460	305	3	580	385	3
351	230	3	460	305	3	580	385	3
360	239	3	480	320	3	610	410	3
369	248	3	480	320	3	610	410	3
397	248	4	505	320	4	635	410	4
406	257	4	530	340	4	665	430	4
416	267	4	530	340	4	665	430	4
426	277	4	555	360	4	695	460	4
436	287	4	555	360	4	695	460	4
447	298	4	585	385	4	735	490	4
459	310	4	585	385	4	735	490	4
470	321	4	605	405	4	765	510	4

Lip clearance angle

Lip clearance angle on HSS and HSS-E twist drills

Diameter range		Type N, type H and for the step at centre drills	
Drill-Ø in mm over	up to	Lip clearance angle α_x	Point angle
0.14 –	0.24	28°	118°
0.24 –	0.48	25°	118°
0.48 –	0.95	23°	118°
0.95 –	2.36	20°	118°
2.36 –	6.00	15°	118°
6.00 –	15.00	13°	118°
15.00 –	37.50	10°	118°
37.50 –	100.00	8°	118°

The data listed is intended as a guide and represent average values.

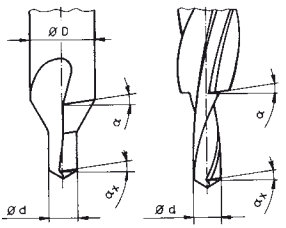
Lip clearance angle on coutersink for: subland drills, step drills and centre drills

Diameter range		Type N, type S countersink angle		Type W, type H, countersink angle
		20 - 160°	161 - 180°	20 - 160°
Drill-Ø in mm over	up to	Lip clearance angle α_x	Lip clearance angle. α	Lip clearance angle α_x
0.48 –	0.95	–	–	–
0.95 –	2.36	14.0°	8°	16°
2.36 –	3.75	13.0°	7°	15°
3.75 –	6.00	12.5°	6.5°	14°
6.00 –	9.50	11.0°	6°	13°
9.50 –	15.00	10.0°	5°	12°
15.00 –	23.60	9.5°	5°	11°
23.60 –	37.50	9.0°	4.5°	11°
37.50 –	60.00	8.0°	4°	10°

The data listed is intended as a guide and represent average values.

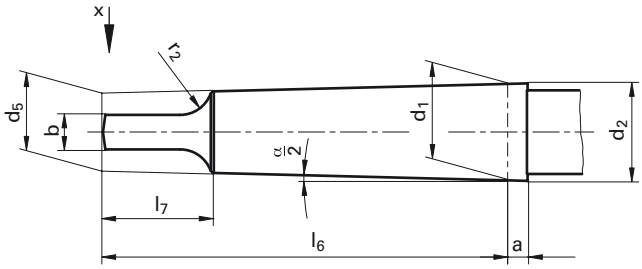
Type W, type FN, type FW, type S, type IS		Type V	
Lip clearance angle α_x	Point angle	Lip clearance angle α_x	Point angle
28°	130°	28°	130°
25°	130°	25°	130°
23°	130°	23°	130°
20°	130°	20°	130°
15°	130°	15°	130°
13°	130°	13°	130°
10°	130°	10°	130°
8°	130°	8°	130°

	Centre drills
161 - 180°	
Lip clearance angle α	Lip clearance angle on the shank-Ø d
–	7°
9°	7°
8°	6°
7°	5°
7°	4°
6°	4°
6°	–
5°	–
5°	–

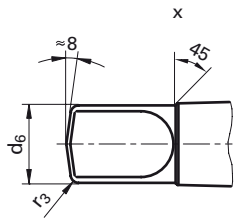


Shank designs for morse taper with flat tang according to DIN 228 form B

Shank to DIN 228 form B size	a	tol. zone	b h13	d_1	$d_2 \approx$	$d_5 \approx$
MT 0	3.0	+1.2 0	3.9	9.045	9.2	6.1
MT 1	3.5	+1.4 0	5.2	12.065	12.2	9.0
MT 2	5.0	+1.4 0	6.3	17.780	18.0	14.0
MT 3	5.0	+1.7 0	7.9	23.825	24.1	19.1
MT 4	6.5	+1.9 0	11.9	31.267	31.6	25.2
MT 5	6.5	+1.9 0	15.9	44.399	44.7	36.5
MT 6	8.0	+2.3 0	19.0	63.348	63.8	52.4



d_6 max.	l_6 -1	l_7 max.	r_2 max.	r_3	$\frac{\alpha}{2}$
6	56.5	10.5	4	1	1°29′27″
8.7	62	13.5	5	1.2	1°25′43″
13.5	75	16	6	1.6	1°25′50″
18.5	94	20	7	2	1°26′16″
24.5	117.5	24	8	2.5	1°29′15″
35.7	149.5	29	10	3	1°30′26″
51.0	210.0	40	13	4	1°29′36″



Tapping hole diameters

ISO metric threads (dim. acc. to DIN 336,

Thread	Drill-Ø mm	Thread
M 1	0.75	M 4.5
M 1.1	0.85	M 5
M 1.2	0.95	M 5.5
M 1.4	1.10	M 6
M 1.6	1.25	M 7
M 1.7	1.35	M 8
M 1.8	1.45	M 9
M 2	1.60	M 10
M 2.2	1.75	M 11
M 2.3	1.85	M 12
M 2.5	2.05	M 14
M 2.6	2.10	M 16
M 3	2.50	M 18
M 3.5	2.90	M 20
M 4	3.30	M 22

ISO metric fine threads (dim. acc. to DIN 336,

Thread	Drill-Ø mm	Thread
M 3 x 0.35	2.65	M 12 x 1.5
M 3.5 x 0.35	3.15	M 14 x 1.5
M 4 x 0.5	3.50	M 16 x 1.5
M 4.5 x 0.5	4.00	M 18 x 1.5
M 5 x 0.5	4.50	M 20 x 1.5
M 5.5 x 0.5	5.00	M 22 x 1.5
M 6 x 0.75	5.20	M 24 x 1.5
M 7 x 0.75	6.20	M 25 x 1.5
M 8 x 0.75	7.20	M 27 x 1.5
M 9 x 1	8.00	M 28 x 1.5
M 10 x 1	9.00	M 30 x 1.5
M 11 x 1	10.00	M 32 x 1.5

BSP threads (dim. acc. to DIN 336, proposal 04/97)

Thread	Drill-Ø mm	Thread
G 1/8“	8.80	G 1 1/8“
G 1/4“	11.80	G 1 1/4“
G 3/8“	15.25	G 1 3/8“
G 1/2“	19.00	G 1 1/2“
G 5/8“	21.00	G 1 3/4“
G 3/4“	24.50	G 2“
G 7/8“	28.25	G 2 1/4“
G 1“	30.75	G 2 1/2“

proposal 04/97)

Drill-Ø mm	Thread	Drill-Ø mm
3.70	M 24	21.00
4.20	M 27	24.00
4.70	M 30	26.50
5.00	M 33	29.50
6.00	M 36	32.00
6.80	M 39	35.00
7.80	M 42	37.50
8.50	M 45	40.50
9.50	M 48	43.00
10.20	M 52	47.00
12.00	M 56	50.50
14.00	M 60	54.50
15.50	M 64	58.00
17.50	M 68	62.00
19.50	M 72	66.00

proposal 04/97)

Drill-Ø mm	Thread	Drill-Ø mm
10.50	M 33 x 1.5	31.50
12.50	M 35 x 1.5	33.50
14.50	M 36 x 1.5	34.50
16.50	M 38 x 1.5	36.50
18.50	M 39 x 1.5	37.50
20.50	M 40 x 1.5	38.50
22.50	M 42 x 1.5	40.50
23.50	M 45 x 1.5	43.50
25.50	M 48 x 1.5	46.50
26.50	M 50 x 1.5	48.50
28.50		
30.50		

Drill-Ø mm	Thread	Drill-Ø mm
35.50	G $2^3/_4$“	79.00
39.50	G 3“	82.25
41.50	G $3^1/_4$“	91.50
45.25	G $3^1/_2$“	97.75
51.00	G $3^3/_4$“	104.00
57.00	G 4“	110.50
63.00		
72.50		

The new material abbreviations (selection)

Material no.	Abbreviation old	Abbreviation new
0.6010	GG10	EN-GJL-100
0.6020	GG20	EN-GJL-200
0.6025	GG25	EN-GJL-250
0.6035	GG35	EN-GJL-350
0.7050	GGG50	EN-GJS-500-7
0.7070	GGG70	EN-GJS-700-2
0.8035	GTW35	EN-GJMW-350-4
0.8155	GTS55	EN-GJMB-550-4
0.8170	GTS70	EN-GJMB-700-2
1.0022	St 01Z	–
1.0035	St 33	S185
1.0039	St 37 -2	S235JRH
1.0044	St 44 -2	S275JR
1.0050	St 50 -2	E295
1.0060	St 60 -2	E335
1.0070	St 70 –2	E360
1.0114	St 37 –3U	S235J0
1.0226	St 02Z	DX51D
1.0242	StE 250 -2Z	S250GD
1.0244	StE 280 -2Z	S280GD
1.0250	StE 320 -3Z	S320GD
1.0301	C 10	–
1.0302	C 10 Pb	–
1.0306	St 06 Z	DX54D
1.0312	St 15	DC05 [Fe P05]
1.0319	RRStE 210.7	L210GA
1.0322	–	DX56D
1.0330	St 12 [St 2]	DC01 [Fe P01]
1.0333	USt 13	–
1.0338	St 14 [St 4]	DC04 [Fe P04]
1.0345	H I	P235GH
1.0347	RRSt 13 [RRSt 3]	DC03 [Fe P03]
1.0348	UH I	P195GH
1.0350	St 03Z	DX52D
1.0355	St 05Z	DX53D
1.0356	TTSt 35 N	P215NL
1.0358	St 05 Z	–
1.0401	C 15	–
1.0402	C 22	C22
1.0403	C 15 Pb	–
1.0406	C 25	C25
1.0419	St 52.0	L355
1.0424	St 45.8 (ersetzt)	P265
1.0424	St 42.8 (ersetzt)	P265
1.0425	H2	P265GH
1.0429	StE 290.7 TM	L290MB
1.0457	StE 240.7	L245NB
1.0459	RRStE 240.7	L245GA
1.0461	StE 255	S255N
1.0473	19 Mn 6	P355GH
1.0481	17 Mn 4	P295GH
1.0484	StE 290.7	L290NB
1.0486	StE 285	P275N
1.0501	C 35	C35
1.0503	C 45	C45
1.0505	StE 315	P315N
1.0511	C 40	C40
1.0528	C 30	C30
1.0529	StE 350 -3Z	S350GD
1.0535	C 55	C55
1.0539	StE 355N	S355NH
1.0540	C 50	C50
1.0547	St 52 –3U	S355J0H
1.0582	StE 360.7	L360NB
1.0601	C 60	C60
1.0710	15 S 10	–
1.0715	9 SMn 28	11SMn30
1.0718	9 SMnPb 28	11SMnPb30
1.0721	10 S 20	10S20
1.0722	10 S Pb 20	10SPb20
1.0726	35 S 20	35S20
1.0727	45 S 20	46S20

Material no.	Abbreviation old	Abbreviation new
1.0728	60 S 20	–
1.0736	9 SMn 36	11SMn37
1.0737	9 SMnPb 36	11SMnPb37
1.0756	35 SPb 20	35SPb20
1.0757	45 SPb 20	46SPb20
1.0760	–	38SMn26
1.0761	–	38SMnPb26
1.0762	–	44SMn28
1.0763	–	44SMnPb28
1.0873	–	DC06 [Fe P06]
1.1103	EStE 255	S255NL1
1.1105	EStE 315	S315NL1
1.1121	Ck 10	C10E
1.1141	Ck15	C15E
1.1151	Ck 22	C22E
1.1158	Ck 25	C25E
1.1170	28 Mn 6	28Mn6
1.1178	Ck 30	C30E
1.1181	Ck 35	C35E
1.1186	Ck 40	C40E
1.1191	Ck 45	C45E
1.1203	Ck 55	C55E
1.1206	Ck 50	C50E
1.1221	Ck 60	C60E
1.1241	Cm 50	C50R
1.1750	C 75 W	C75W
1.2067	102 Cr 6	102Cr6
1.2080	–	X210Cr12
1.2083	–	X42Cr13
1.2419	–	105WCr6
1.2767	–	X45NiCrMo4
1.3243	S6-5-2-5	S 6-5-2-5
1.3343	S6-5-2	S 6-5-2
1.3344	S6-5-3	S 6-5-3
1.4000	X6Cr 13	X6Cr13
1.4002	X6CrAl 13	X6CrAl13
1.4003	X2Cr 11	X2CrNi12
1.4005	–	X12CrS13
1.4006	X10Cr 13	X12Cr13
1.4016	X6Cr 17	X6Cr17
1.4021	X20Cr 13	X20Cr13
1.4028	X30Cr 13	X30Cr13
1.4031	X38Cr 13	X38Cr13
1.4034	X46Cr 13	X46Cr13
1.4037	X65Cr13	X65Cr13
1.4057	X20CrNi 17 2	X17CrNi16-2
1.4104	X12CrMoS 17	X14CrMoS17
1.4105	X4CrMoS 18	X6CrMoS17
1.4109	X65CrMo 14	X70CrMo15
1.4110	X55CrMo 14	X55CrMo14
1.4112	X90CrMoV 18	X90CrMoV18
1.4113	X6CrMo 17 1	X6CrMo17-1
1.4116	X45CrMoV 15	X50CrMoV15
1.4120	X20CrMo 13	X20CrMo13
1.4122	X35CrMo 17	X39CrMo17-1
1.4125	X105CrMo 17	X105CrMo17
1.4301	X5CrNi 18 10	X5CrNi18-10
1.4303	X5CrNi 18 12	X4CrNi18-12
1.4305	X10CrNiS 18 9	X8CrNiS18-9
1.4306	X2CrNi 19 11	X2CrNi19-11
1.4310	X12CrNi 17 7	X10CrNi18-8
1.4311	X2CrNiN 18 10	X2CrNiN18-10
1.4313	X4CrNi 13 4	X3CrNiMo13-4
1.4318	X2CrNiN 18 7	X2CrNiN18-7
1.4335	X1CrNi 25 21	X1CrNi25-21
1.4361	X1CrNiSi 18 15	X1CrNiSi18-15-4
1.4362	X2CrNiN 23 4	X2CrNiN23-4
1.4401	X5CrNiMo 17 12 2	X5CrNiMo17-12-2
1.4404	X2CrNiMo 17 13 2	X2CrNiMo17-12-2
1.4410	X10CrNiMo 18 9	X2CrNiMoN25-7-4
1.4418	X4CrNiMo 16 5	X4CrNiMo16-5-1
1.4435	X2CrNiMo 18 14 3	X2CrNiMo18-14-3

Material no.	Abbreviation old	Abbreviation new
1.4436	X5CrNiMo 17 13 3	X3CrNiMo17-13-3
1.4438	X2CrNiMo 18 16 4	X2CrNiMo18-15-4
1.4460	X4CrNiMo 27 5 2	X3CrNiMoN27-5-2
1.4462	X2CrNiMoN 22 5 3	X2CrNiMoN22-5-3
1.4509	X6CrTiNb 18	X2CrTiNb18
1.4510	X6CrTi 17	X3CrTi17
1.4511	X6CrNb 17	X3CrNb17
1.4512	X6CrTi 12	X2CrTi12
1.4520	X1CrTi 15	X2CrTi17
1.4521	X2CrMoTi 18 2	X2CrMoTi18-2
1.4522	X2CrMoNb 18 2	X2CrMoNb18-2
1.4532	X7CrNiMoAl 15 7	X8CrNiMoAl15-7-2
1.4541	X6CrNiTi18 10	X6CrNiTi18-10
1.4542	X5CrNiCuNb 17 4	X5CrNiCuNb16-4
1.4550	X6CrNiNb 18 10	X6CrNiNb18-10
1.4558	X2NiCrAlTi 32 20	X2NiCrAlTi32-20
1.4567	X3CrNiCu 18 9 X	X3CrNiCu18-9-4
1.4568	X7CrNiAl 17 7	X7CrNiAl17-7
1.4571	–	X6CrNiMoTi17-12-2
1.4577	X3CrNiMoTi 25 25	X3CrNiMoTi25-25
1.4592	X1CrMoTi 29 4	X2CrMoTi29-4
1.4713	X10CrAl 7	X10CrAlSi7
1.4724	X10CrAl 13	X10CrAlSi13
1.4742	X10CrAl 18	X10CrAlSi18
1.4762	X10CrAl 24	X10CrAlSi25
1.4821	X20CrNiSi 25 4	X20CrNiSi25-4
1.4828	X15CrNiSi 20 12	X15CrNiSi20-12
1.4833	X7CrNi 23 14	X7CrNi23-12
1.4841	X15CrNiSi 25 20	X15CrNiSi25-21
1.4845	X12CrNi 25 21	X12CrNi25-21
1.4864	X12NiCrSi 36 16	X12NiCrSi35-16
1.4878	X12CrNiTi18 9	X10CrNiTi18-10
1.4903	–	X10CrMoVNb9-1
1.5026	55 Si 7	55Si7
1.5131	50 MnSi 4	50MnSi4
1.5415	15 Mo 3	16Mo3
1.5530	21 MnB 5	20MnB5
1.5531	30 MnB 5	30MnB5
1.5532	38 MnB 5	38MnB5
1.5637	10 Ni 14	12Ni14
1.5662	–	X11CrMo5+I
1.5680	–	X12Ni5
1.5710	36 NiCr 6	36NiCr6
1.5715	–	16NiCrS4
1.5752	14 NiCr 14	15NiCr13
1.6210	15 MnNi 6 3	15MnNi6-3
1.6211	16 MnNi 6 3	16MnNi6-3
1.6310	20 MnMoNi 5 5	20MnMoNi5-5
1.6311	20 MnMoNi 4 5	20MnMoNi4-5
1.6341	11 NiMoV 5 3	11NiMoV5-3
1.6368	15 NiCuMoNb 5	15NiCuMoNb5
1.6511	36 CrNiMo 4	36CrNiMo4
1.6523	21 NiCrMo 2	21NiCrMo2-2
1.6526	21 NiCrMoS 2	21NiCrMoS2-2
1.6580	30 CrNiMo 8	30CrNiMo8
1.6582	34 CrNiMo 6	34CrNiMo6
1.6587	17 CrNiMo 6	18CrNiMo7-6
1.7003	38 Cr 2	38Cr2
1.7006	46 Cr 2	46Cr2
1.7016	17 Cr 3	17Cr3
1.7023	38 CrS 2	38CrS2
1.7025	46 CrS 2	46CrS2
1.7030	28 Cr 4	28Cr4
1.7033	34 Cr 4	34Cr4
1.7034	37 Cr 4	37Cr4
1.7035	41 Cr 4	41Cr4
1.7036	28 CrS 4	28CrS4
1.7037	34 CrS 4	34CrS4
1.7038	37 CrS 4	37CrS4
1.7039	41 CrS 4	41CrS4
1.7131	16 MnCr 5	16MnCr5
1.7139	16 MnCrS 5	16MnCrS5

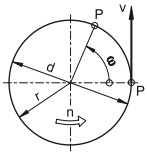
Material no.	Abbreviation old	Abbreviation new
1.7043	–	38Cr4
1.7147	20 MnCr 5	20MnCr5
1.7149	20 MnCrS 5	20MnCrS5
1.7176	55 Cr 3	55Cr3
1.7182	27 MnCrB 5 2	27MnCrB5-2
1.7185	33 MnCrB 5 2	33MnCrB5-2
1.7189	39 MnCrB 6 2	39MnCrB6-2
1.7213	25 CrMoS 4	25CrMoS4
1.7218	25 CrMo 4	25CrMo4
1.7219	–	26CrMo4-2
1.7220	34 CrMo 4	34CrMo4
1.7225	42 CrMo 4	42CrMo4
1.7226	34 CrMoS 4	34CrMoS4
1.7227	42 CrMoS 4	42CrMoS4
1.7228	50 CrMo 4	50CrMo4
1.7264	20 CrMo 5	20CrMo5
1.7321	20 MoCr 4	20MoCr4
1.7323	20 MoCrS 4	20MoCrS4
1.7333	22 CrMoS 3 5	22CrMoS3-5
1.7335	13 CrMo 4 4	13CrMo4-5
1.7362	12 CrMo 19 5	12CrMo19-5
1.7380	10 CrMo 9 10	10CrMo9-10
1.7383	–	11CrMo9-10
1.7779	–	20CrMoV13-5-5
1.8159	50 CrV 4	51CrV4
1.8504	34 CrAl 6	34CrAl6
1.8519	31 CrMoV 9	31CrMoV9
1.8550	34 CrAlNi 7	34CrAlNi7
1.8807	13 MnNiMoV 5 4	13MnNiMoV5-4
1.8812	18 MnMoV 5 2	18MnMoV5-2
1.8815	18 MnMoV 6 3	18MnMoV6-3
1.8821	StE 355 TM	P355M
1.8824	StE 420 TM	P420M
1.8826	StE 460 TM	P460M
1.8828	EStE 420 TM	P420ML2
1.8831	EStE 460 TM	P460ML2
1.8832	TStE 355 TM	P355ML1
1.8835	TStE 420 TM	P420ML1
1.8837	TStE 460 TM	P460ML1
1.8879	StE ...	P690Q
1.8880	WStE ...	P690QH
1.8881	TStE ...	P690QL1
1.8882	10 MnTi 3	10MnTi3
1.8888	EStE ...	P690QL2
1.8900	StE 380	S380N
1.8901	StE 460	S460N
1.8902	StE 420	S420N
1.8903	TStE 460	S460NL
1.8905	StE 460	P460N
1.8907	StE 500	S500N
1.8910	TStE 380	S380NL
1.8911	EStE 380	S380NL1
1.8912	TStE 420	S420NL
1.8913	EStE 420	S420NL1
1.8915	TStE 460	P460NL1
1.8917	WStE 500	S500NL
1.8918	EStE 460	P460NL2
1.8919	EStE 500	S500NL1
1.8930	WStE 380	P380NH
1.8932	WStE 420	P420NH
1.8935	WStE 460	P460NH
1.8937	TStE 500	P500NH
1.8972	StE 415.7	L415NB
1.8973	StE 415.7 TM	L415MB
1.8975	StE 445.7 TM	L450MB
1.8977	StE 480.7 TM	L485MB
1.8978	StE 550.7 TM	L555MB

Contents by article no.

Calculation formulae for drilling processes

HARTNER

Circular motion



v_c Cutting speed
(= v Surface speed)
v_f Feed rate

ω Angular velocity

n Revolutions per min.
r Radius

d Diameter
f Feed mm/rev.

$v_c = r \cdot \omega$ — Cutting speed = radius x angular velocity

$v_c = \pi \cdot d \cdot n$ — Cutting speed = π x diameter x revolutions per min.

$\omega = 2\,\pi \cdot n$ — Angular velocity = 2 π x revolutions per min.

$v_f = n \cdot f$ — Feed rate = revolutions per min. x feed rate

Calculation of essential operating time (machine time)

$$t_h = \frac{L \cdot i}{f \cdot n}$$

t_h in min — essential operating time
L in min — total drilling length
i — no. of drilling operations
f in mm — feed per revolution
n in min^{-1} — revolutions per min.

$$n = \frac{v_c \cdot 10^3\ mm/m}{d \cdot \pi}$$

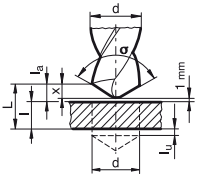
n in min^{-1} — revolutions per min.
v_c in m/min — cutting speed
d in mm — drill diameter

$$L = l_a + l + l_u + l_s$$

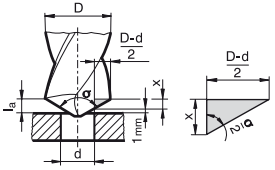
L in mm — total drilling length
l_a in mm — feed movement to cutting point
l in mm — length of hole
l_u in mm — feed length
l_s = 0,3

$l_a = x + 1$

a) Drilling into solid



b) Core drilling using a twist drill



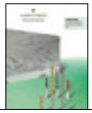
$$x = \frac{d}{2 \cdot \tan\frac{\delta}{2}}$$

x in mm — length of drill point
d in mm — drill diameter
in ° — drill point diameter

$$x = \frac{D - d}{2 \cdot \tan\frac{\delta}{2}}$$

x in mm — point length
D in mm — finished hole diameter
d in mm — pre drilling diameter
δ in mm — point angle

Our program:


FU 500/FN500


Gun Drills


INOX-Drills


Standard Solid Carbide De-burring Tools


Micro Precision Drills


Multiplex


TS-Drills


Standard Range


Highlights


TM Vending Machines


Special Drills


Multiplex HPC

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