HARTNER

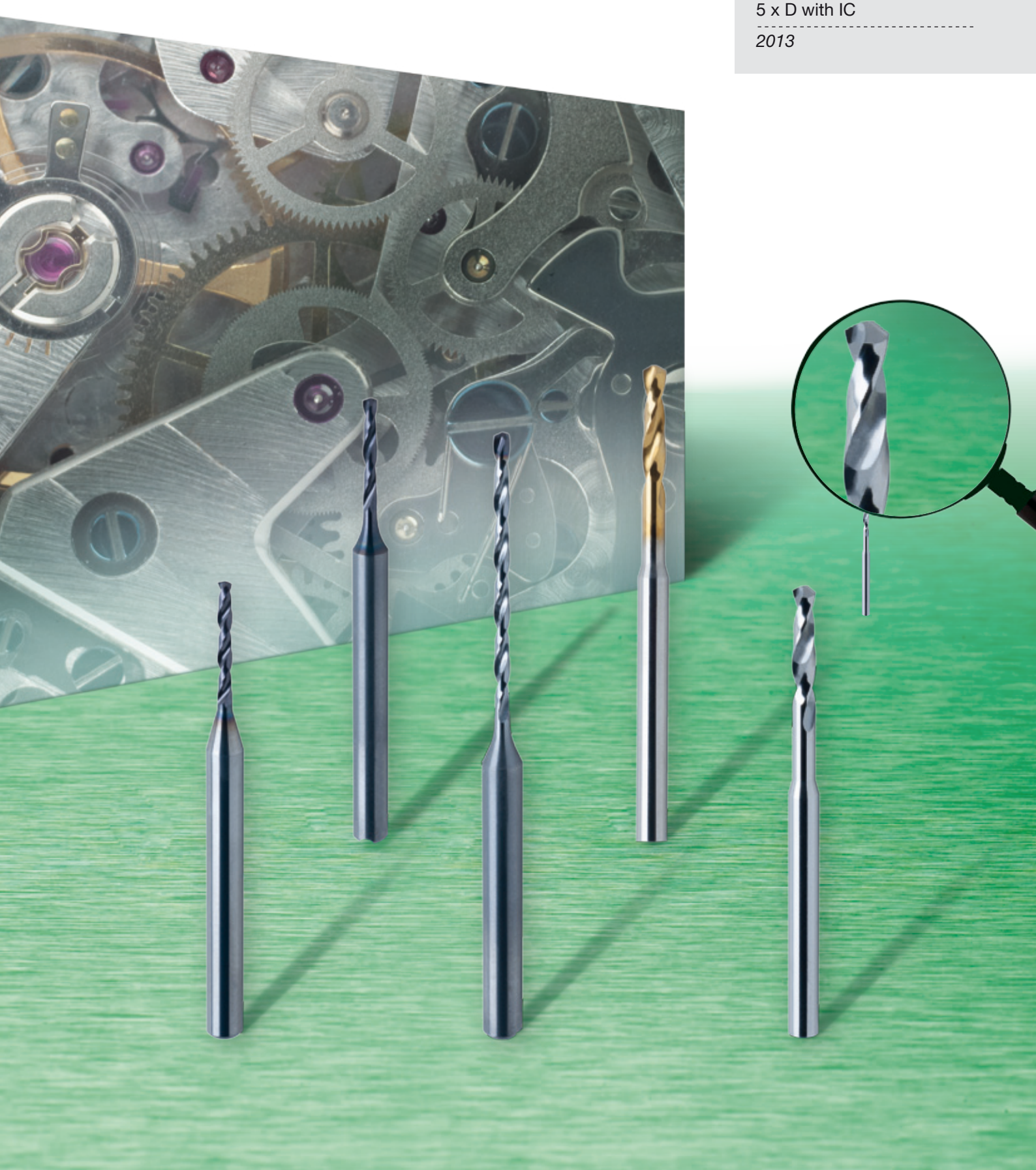
Precision Cutting Tools

Micro-Precision Drills

HSS-E-PM / Solid Carbide

New: Solid carbide
micro-precision drills
5 x D with IC

2013



HARTNER

Micro-precision drills without oil feed

Hartner HSS-E-PM and Solid Carbide Micro Drills – Precision starting from Diameter 0.05 mm

Smallest borings require highest quality, as the least deviation in the straightness of the boring, in the tolerance or in the surface quality on the workpiece will already mean a defect or scrap in today's miniaturised productions. For micro productions, Hartner offers precision micro drills made of HSS-E-PM and solid carbide in nominal diameters from 0.05 and 0.2 mm respectively.

Point- and flute geometry, surfaces, shank types and cutting materials are perfectly concerted to match the application, so that smallest borings are worked out well and fabricated process-safe. Our HSS-E-PM micro drills are especially applied for small-series productions, where they offer high quality at a beneficial cost-performance ratio.

On the one hand, Hartner solid carbide micro drills, as drills with a long tool life, stand by for large-scale productions. On the other hand, with the article no. 89286 we also offer a specialist for processing glass fibre reinforced plastics (GRP) in the electric and electronic industry.

See the quality and performance of our micro drills for yourself. Numerous customers in the branches of precision mechanics, horology, medical technology, conductor board manufacturing and other fields of the micro production already rely on Hartner.

Order no. 87011

from page 7

A special purpose drill with oversize shank for use in the instrument and clock making industries and for general precision engineering.
Specially designed for drilling structural and carbon steels, high-alloyed steels, tool steels, cast und castalloys, Magnesium-alloys, Aluminium and plastics.

Standard	DIN 1899
Tool material	HSS-E-PM
Surface	○
Type	N
Cutting direction	right-hand
Point grinding	Facet point
Point angle°	118
Web thinned ≥ Ø	
Tolerance	0/-0,004

Order no. 87016

from page 7

A special purpose drill with oversize shank for use in the instrument and clock making industries and for general precision engineering.
Specially designed for drilling structural and carbon steels, high-alloyed steels, tool steels, cast und castalloys, Magnesium-alloys, Aluminium and plastics.

Standard	DIN 1899
Tool material	HSS-E-PM
Surface	○
Type	N
Cutting direction	left-hand
Point grinding	Facet point
Point angle°	118
Web thinned ≥ Ø	
Tolerance	0/-0,004

○ bright (A) TiAlN (A) AlTiN (T) TiN

HARTNER

Micro-precision drills without oil feed

Order no. 84810

from page 7

A special purpose drill with oversize shank for use in the instrument and clock making industries and for general precision engineering.
Specially designed for drilling structural and carbon steels, high-alloyed steels, tool steels, cast und castalloys, Magnesium-alloys, Aluminium and plastics.

Standard	DIN 1899
Tool material	HSS-E-PM
Surface	T
Type	N
Cutting direction	right-hand
Point grinding	Facet point
Point angle°	118
Web thinned ≥ Ø	
Tolerance	0/-0,004

Order no. 89281

from page 7

A special purpose drill with oversize shank for use in the instrument and clock making industries and for general precision engineering.
Specially designed for drilling structural and carbon steels, high-alloyed steels, tool steels, cast und castalloys, Magnesium-alloys, Aluminium and plastics.

Standard	Hartner std.
Tool material	Solid carbide
Surface	○
Type	N
Cutting direction	right-hand
Point grinding	Facet point
Point angle°	130
Web thinned ≥ Ø	
Tolerance	0/-0,004

Order no. 86402

from page 11

NEW

Micro drill for universal application with a uniform 3 mm shank and a uniform 38 mm total length. By using just one uniform carbide bar for the production of all diameters and due to large batch sizes, a good cost-effectiveness is achieved. The combination of solid carbide and the TiAlN-coating with a special flute geometry enables optimal chip evacuation also at higher cutting speeds and feeds. Good suitability for the machining of electronic circuit boards.

Standard	Hartner std.
Tool material	Solid carbide
Surface	A
Type	N
Cutting direction	right-hand
Point grinding	Facet point
Point angle°	140
Web thinned ≥ Ø	0.80
Tolerance	h7

Order no. 89286

from page 13

Specially designed drill for drilling fiberglass reinforced plastics (i.e. printed circuit boards) and other resin-based thermo-hardened products likely to cause rapid wear on the lands and cutting edges of high speed steel drills.

Standard	Hartner std.
Tool material	Solid carbide
Surface	○
Type	N
Cutting direction	right-hand
Point grinding	Relieved cone
Point angle°	130
Web thinned ≥ Ø	
Tolerance	h7

○ bright A TiAlN A AlTiN T TiN

HARTNER

Solid carbide Micro-precision drills for high performance machining

Small but mighty - with and without internal cooling

Solid carbide micro-precision drills without internal cooling for drilling depths up to 4xD and 7xD are available in the diameter range from 0.8 to 3.0 mm.

Holes up to 5xD, 8xD and 15xD are the domain of solid carbide micro-precision drills with internal cooling. Thanks to the optimised tool geometry, pecking is not required for holes up to 15xD with Hartner's solid carbide micro-precision drills.

The tool design makes the solid carbide micro-precision drill 4xD without internal cooling optimally suitable as a pilot drill for the 15xD micro precision drill with internal cooling.

Superior in every sense

Solid carbide micro-precision drills have proven their exceptional performance capabilities in various volume applications and tool life tests. The tables below document a few application examples with convincing results.

Machining examples of solid carbide micro-precision drills 8xD and 15xD with IC

Hartner no.	86408	86408	86412	86412
Diameter	1.4 mm	2.5 mm	2.5 mm	2.1 mm
Coating	AlTiN	AlTiN	AlTiN	AlTiN
Material group	cast iron	alloyed case hardened steel	alloyed heat-treatable steel	stainless steel
Material description	GG25	16MnCr5	42CrMo4	X6CrNiTi18 10
Drill. depth [mm]	8xD	8xD	15xD	15xD
Hole type	blind hole	blind hole	blind hole	blind hole
Cooling	IC 80 bar	IC 80 bar	IC 80 bar	IC 80 bar
Coolant	soluble oil	soluble oil	soluble oil	soluble oil
Machine type	machining centre	machining centre	machining centre	machining centre
v_c [mm/min]	80	120	100	60
f [mm/rev.]	0.1	0.14	0.1	0.03
Tool life [m]	150	110	60	60

Internal cooling increases tool life considerably!

A comparison between a conventional micro-precision drill w/o internal cooling for holes up to 7xD and a 8xD drill with internal cooling 86408 demonstrates the advantages of internal cooling: Tool life increases considerably.

Hartner no.	Competitor without internal cooling	86408 with internal cooling
Diameter	2.6 mm	2.6 mm
Coating	TiAlN	AlTiN
Material group	stainless steel	stainless steel
Material description	X105CrMo17	X105CrMo17
Drill. depth [mm]	7xD	8xD
Hole type	blind hole	blind hole
Cooling	external	internal 100 bar
Coolant	neat oil	neat oil
Machine type	machining centre	machining centre
v_c [mm/min]	53	53
f [mm/rev.]	0.06	0.06
Tool life [m]	100 workpieces	500 workpieces, end of tool life not reached!

Micro-precision drills without oil feed

Order no. 86400

page 14

Solid carbide special drill with AlTiN-coating and reinforced shank without internal cooling for drilling small holes up to 4 x D boring depth particularly for steel. Also applicable for machining cast iron.
The special flute geometry enables optimal chip break and chip removal also at higher cutting speeds and feeds. The two-facet point grinding on every cutting edge and the special web thinning ensure a good self-centering.

Standard	Hartner std.
Tool material	Solid carbide
Surface	A
Type	N
Cutting direction	right-hand
Point grinding	Facet point
Point angle°	140
Web thinned ≥ Ø	0.80
Tolerance	m7

Order no. 86401

page 15

Solid carbide special drill with AlTiN-coating and reinforced shank without internal cooling for drilling small holes up to 7 x D boring depth particularly for steel. Also applicable for machining cast iron.
The special flute geometry enables optimal chip break and chip removal also at higher cutting speeds and feeds. The two-facet point grinding on every cutting edge and the special web thinning ensure a good self-centering.

Standard	Hartner std.
Tool material	Solid carbide
Surface	A
Type	N
Cutting direction	right-hand
Point grinding	Facet point
Point angle°	140
Web thinned ≥ Ø	0.80
Tolerance	m7

○ bright A TiAlN A AlTiN T TiN

Micro-precision drills with oil feed

Order no. 86405

page 16

NEW

Solid carbide special drill with AlTiN coating, reinforced shank and internal coolant supply for drilling small holes with drilling depths up to 5xD especially in steel. Also suitable for cast machining. The special flute geometry enables optimal chip break and ship removal even with high feeds and speeds. The two-facet point grind and the special web thinning offer good selfcentering.

Standard	Hartner std.
Tool material	Solid carbide
Surface	A
Type	N
Cutting direction	right-hand
Point grinding	Facet point
Point angle°	140
Web thinned ≥ Ø	1.40
Tolerance	m7

Order no. 86408

page 17

Solid carbide special drill with AlTiN coating, reinforced shank and internal coolant supply for drilling small holes with drilling depths up to 8xD especially in steel. Also suitable for cast machining. The special flute geometry enables optimal chip break and ship removal even with high feeds and speeds. The two-facet point grind and the special web thinning offer good selfcentering. The micro-precision drill order no. 86400 is the perfect pilot drill thanks to its 140° point angle.

Standard	Hartner std.
Tool material	Solid carbide
Surface	A
Type	N
Cutting direction	right-hand
Point grinding	Facet point
Point angle°	135
Web thinned ≥ Ø	1.40
Tolerance	h7

Order no. 86412

page 17

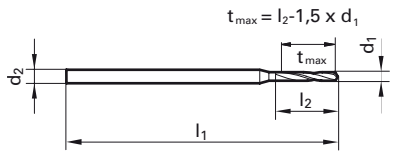
Solid carbide special drill with AlTiN coating, reinforced shank and internal coolant supply for drilling small holes with drilling depths up to 15xD especially in steel. Also suitable for cast machining. The special flute geometry enables optimal chip break and ship removal even with high feeds and speeds. The two-facet point grind and the special web thinning offer good selfcentering. The micro-precision drill order no. 86400 is the perfect pilot drill thanks to its 140° point angle.

Standard	Hartner std.
Tool material	Solid carbide
Surface	A
Type	N
Cutting direction	right-hand
Point grinding	Facet point
Point angle°	135
Web thinned ≥ Ø	1.40
Tolerance	h7

○ bright A TiAlN A AlTiN T TiN

HARTNER

Micro-precision drills without oil feed



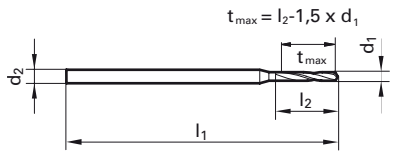
				87011	87016	84810	89281
				HSS-E-PM			Solid carbide
				134	138	135	102
				right-hand	left-hand	right-hand	right-hand
				N	N	N	N
				○	○	(T)	○
d1	d2	l1	l2	Availability			
mm	mm	mm	mm				
0.050	1.000	25.00	0.40	●			
0.060	1.000	25.00	0.40	●			
0.080	1.000	25.00	0.50	●			
0.090	1.000	25.00	0.50	●			
0.100	1.000	25.00	0.50	●			
0.110	1.000	25.00	0.50	●			
0.120	1.000	25.00	0.50	●			
0.130	1.000	25.00	0.80	●			
0.140	1.000	25.00	0.80	●			
0.150	1.000	25.00	0.80	●	❍		
0.160	1.000	25.00	1.10	●	●		
0.170	1.000	25.00	1.10	●	❍		
0.180	1.000	25.00	1.10	●	❍		
0.190	1.000	25.00	1.10	●	●		
0.200	1.000	25.00	1.50	●	●	●	●
0.205	1.000	25.00	1.50	●			
0.210	1.000	25.00	1.50	●	❍		
0.215	1.000	25.00	1.50	❍			
0.220	1.000	25.00	1.50	●	●		
0.225	1.000	25.00	1.50	●			
0.230	1.000	25.00	1.50	●	❍		
0.235	1.000	25.00	1.50	●			
0.240	1.000	25.00	1.50	●	●		
0.245	1.000	25.00	1.90	●			
0.250	1.000	25.00	1.90	●			
0.255	1.000	25.00	1.90	●			
0.260	1.000	25.00	1.90	●			
0.265	1.000	25.00	1.90	●			
0.270	1.000	25.00	1.90	●	●		
0.275	1.000	25.00	1.90	●			
0.280	1.000	25.00	1.90	●	❍		
0.285	1.000	25.00	1.90	●			
0.290	1.000	25.00	1.90	●	●		
0.295	1.000	25.00	1.90	●			
0.300	1.000	25.00	1.90	●	●	●	●
0.310	1.000	25.00	2.40	●	●		
0.315	1.000	25.00	2.40	●			
0.320	1.000	25.00	2.40	●			
0.325	1.000	25.00	2.40	●			
0.330	1.000	25.00	2.40	●	●		
0.335	1.000	25.00	2.40	●			
0.340	1.000	25.00	2.40	●	●		
0.345	1.000	25.00	2.40	●			
0.350	1.000	25.00	2.40	●	●		●
0.355	1.000	25.00	2.40	●			
0.360	1.000	25.00	2.40	●	●		
0.365	1.000	25.00	2.40	●			
0.370	1.000	25.00	2.40	●	●		
0.375	1.000	25.00	2.40	●			
0.380	1.000	25.00	2.40	●	●		
0.385	1.000	25.00	3.00	●			
0.390	1.000	25.00	3.00	●	●		
0.400	1.000	25.00	3.00	●	●		●
0.405	1.000	25.00	3.00	●			

Intermediate sizes available.

○ bright (A) TiAlN (A) AlTiN (T) TiN

HARTNER

Micro-precision drills without oil feed



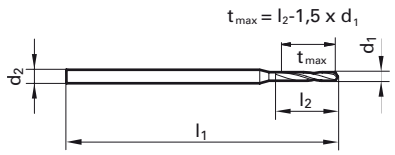
				87011	87016	84810	89281
				HSS-E-PM			Solid carbide
				134	138	135	102
				right-hand	left-hand	right-hand	right-hand
				N	N	N	N
				○	○	T	○
d1	d2	l1	l2	Availability			
mm	mm	mm	mm				
0.410	1.000	25.00	3.00	●	●		
0.415	1.000	25.00	3.00	❍			
0.420	1.000	25.00	3.00	●	❍		
0.425	1.000	25.00	3.00	●			
0.430	1.000	25.00	3.00	●	●		
0.435	1.000	25.00	3.00	●			
0.440	1.000	25.00	3.00	●	●		
0.450	1.000	25.00	3.00	●	●	●	●
0.460	1.000	25.00	3.00	●	●		
0.470	1.000	25.00	3.00	●	●		
0.480	1.000	25.00	3.00	●	●		
0.485	1.000	25.00	3.40	●			
0.490	1.000	25.00	3.40	●	●	●	
0.495	1.000	25.00	3.40	●			
0.500	1.000	25.00	3.40	●	●	●	●
0.505	1.000	25.00	3.40	●			
0.510	1.000	25.00	3.40	●	●	●	
0.515	1.000	25.00	3.40	●			
0.520	1.000	25.00	3.40	●	●	●	
0.525	1.000	25.00	3.40	●			
0.530	1.000	25.00	3.40	●	●		
0.535	1.000	25.00	3.90	●			
0.540	1.000	25.00	3.90	●	❍		
0.550	1.000	25.00	3.90	●	●		
0.555	1.000	25.00	3.90	●			
0.560	1.000	25.00	3.90	●	●		
0.570	1.000	25.00	3.90	●	●		
0.575	1.000	25.00	3.90	●			
0.580	1.000	25.00	3.90	●	●		
0.585	1.000	25.00	3.90	●			
0.590	1.000	25.00	3.90	●	●	●	
0.595	1.000	25.00	3.90	●			
0.600	1.000	25.00	3.90	●	●	●	●
0.605	1.000	25.00	4.20	●			
0.610	1.000	25.00	4.20	●	❍		
0.615	1.000	25.00	4.20	●			
0.620	1.000	25.00	4.20	●	●		
0.625	1.000	25.00	4.20	●			
0.630	1.000	25.00	4.20	●			
0.640	1.000	25.00	4.20	●			
0.650	1.000	25.00	4.20	●			
0.660	1.000	25.00	4.20	●	●		
0.665	1.000	25.00	4.20	●			
0.670	1.000	25.00	4.20	●	●		
0.680	1.000	25.00	4.80	●	❍		
0.690	1.000	25.00	4.80	●	❍		
0.695	1.000	25.00	4.80	●			
0.700	1.000	25.00	4.80	●	●	●	●
0.705	1.000	25.00	4.80	●			
0.710	1.000	25.00	4.80	●	●		
0.720	1.000	25.00	4.80	●			
0.730	1.000	25.00	4.80	●			
0.740	1.000	25.00	4.80	●	●		
0.750	1.000	25.00	4.80	●	●		

Intermediate sizes available.

○ bright A TiAlN A AlTiN T TiN

HARTNER

Micro-precision drills without oil feed



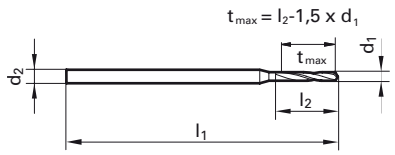
				87011	87016	84810	89281
				HSS-E-PM			Solid carbide
				134	138	135	102
				right-hand	left-hand	right-hand	right-hand
				N	N	N	N
				○	○	T	○
d1	d2	l1	l2	Availability			
mm	mm	mm	mm				
0.760	1.000	25.00	5.30	●	❍	●	
0.770	1.000	25.00	5.30	●			
0.780	1.000	25.00	5.30	●	❍		
0.790	1.000	25.00	5.30	●	●		
0.800	1.500	25.00	5.30	●	●	●	●
0.810	1.500	25.00	5.30	●	●		
0.820	1.500	25.00	5.30	●	●		
0.830	1.500	25.00	5.30	●	●		
0.840	1.500	25.00	5.30	●	❍		
0.850	1.500	25.00	5.30	●	●		
0.860	1.500	25.00	6.00	●	❍		
0.870	1.500	25.00	6.00	●	●		
0.880	1.500	25.00	6.00	●	●	●	
0.890	1.500	25.00	6.00	●	●		
0.900	1.500	25.00	6.00	●	●	●	
0.910	1.500	25.00	6.00	●	❍		
0.920	1.500	25.00	6.00	●	❍	●	
0.930	1.500	25.00	6.00	●	●		
0.940	1.500	25.00	6.00	●	❍		
0.950	1.500	25.00	6.00	●	❍	●	
0.960	1.500	25.00	6.80	●	●		
0.970	1.500	25.00	6.80	●	●		
0.980	1.500	25.00	6.80	●	●	●	
0.990	1.500	25.00	6.80	●	❍		
1.000	1.500	25.00	6.80	●	●	●	●
1.010	1.500	25.00	6.80	●	●		
1.020	1.500	25.00	6.80	●			
1.030	1.500	25.00	6.80	●			
1.040	1.500	25.00	6.80	●	❍		
1.050	1.500	25.00	6.80	●	●	●	
1.060	1.500	25.00	6.80	●	●		
1.070	1.500	25.00	7.60	●			
1.080	1.500	25.00	7.60	●	●		
1.100	1.500	25.00	7.60	●	❍	●	●
1.110	1.500	25.00	7.60	●			
1.120	1.500	25.00	7.60	●			
1.140	1.500	25.00	7.60	●			
1.150	1.500	25.00	7.60	●	●	●	
1.160	1.500	25.00	7.60	●	●		
1.170	1.500	25.00	7.60		●		
1.180	1.500	25.00	7.60	●		●	
1.190	1.500	25.00	8.50	●			
1.200	1.500	25.00	8.50	●	●	●	
1.210	1.500	25.00	8.50	●	●		
1.220	1.500	25.00	8.50		●		
1.230	1.500	25.00	8.50	●			
1.240	1.500	25.00	8.50	●			
1.250	1.500	25.00	8.50	●	❍	●	●
1.260	1.500	25.00	8.50	●			
1.270	1.500	25.00	8.50	●			
1.280	1.500	25.00	8.50	●			
1.290	1.500	25.00	8.50		❍		
1.300	1.500	25.00	8.50	●	●	●	●
1.310	1.500	25.00	8.50	●	❍		

Intermediate sizes available.

○ bright A TiAlN A AlTiN T TiN

HARTNER

Micro-precision drills without oil feed

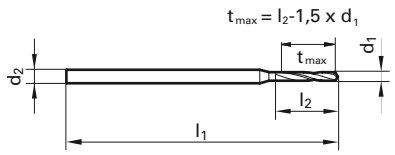


				87011	87016	84810	89281
				HSS-E-PM			Solid carbide
				134	138	135	102
				right-hand	left-hand	right-hand	right-hand
				N	N	N	N
				○	○	T	○
d1	d2	l1	l2	Availability			
mm	mm	mm	mm				
1.320	1.500	25.00	8.50	●	❍		
1.340	1.500	25.00	9.50	●			
1.350	1.500	25.00	9.50	●	❍		
1.380	1.500	25.00	9.50	●			
1.390	1.500	25.00	9.50	●			
1.400	1.500	25.00	9.50	●	●	●	
1.410	1.500	25.00	9.50	●			
1.420	1.500	25.00	9.50	●			
1.430	1.500	25.00	9.50	●			
1.440	1.500	25.00	9.50	●			
1.450	1.500	25.00	9.50	●	●	●	
1.500	2.000	30.00	9.50	●		●	
1.600	2.000	30.00	10.60	●			
1.630	2.000	30.00	10.60	●			
1.700	2.000	30.00	10.60	●			
1.800	2.000	30.00	11.80	●			
1.850	2.000	30.00	11.80	●			
1.900	2.000	30.00	11.80	●			

Intermediate sizes available.

○ bright (A) TiAlN (A) AlTiN (T) TiN

Micro-precision drills without oil feed



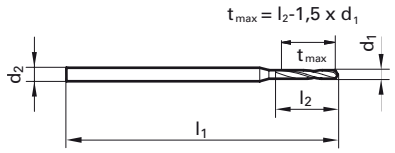
				86402
				Solid carbide
				102
				right-hand
				N
				A
d1	d2	l1	l2	Availability
mm	mm	mm	mm	
0.100	3.000	38.00	1.20	●
0.150	3.000	38.00	2.00	●
0.200	3.000	38.00	2.50	●
0.250	3.000	38.00	3.00	●
0.300	3.000	38.00	5.00	●
0.310	3.000	38.00	5.00	●
0.350	3.000	38.00	6.00	●
0.370	3.000	38.00	6.00	●
0.400	3.000	38.00	7.00	●
0.450	3.000	38.00	7.00	●
0.500	3.000	38.00	7.00	●
0.550	3.000	38.00	7.00	●
0.600	3.000	38.00	7.00	●
0.640	3.000	38.00	7.00	●
0.650	3.000	38.00	7.00	●
0.700	3.000	38.00	8.00	●
0.710	3.000	38.00	8.00	●
0.720	3.000	38.00	8.00	●
0.740	3.000	38.00	8.00	●
0.750	3.000	38.00	8.00	●
0.760	3.000	38.00	8.00	●
0.770	3.000	38.00	8.00	●
0.780	3.000	38.00	8.00	●
0.790	3.000	38.00	8.00	●
0.800	3.000	38.00	10.00	●
0.810	3.000	38.00	10.00	●
0.820	3.000	38.00	10.00	●
0.830	3.000	38.00	10.00	●
0.840	3.000	38.00	10.00	●
0.850	3.000	38.00	10.00	●
0.860	3.000	38.00	10.00	●
0.870	3.000	38.00	10.00	●
0.880	3.000	38.00	10.00	●
0.890	3.000	38.00	10.00	●
0.900	3.000	38.00	10.00	●
0.910	3.000	38.00	10.00	●
0.920	3.000	38.00	10.00	●
0.930	3.000	38.00	10.00	●
0.940	3.000	38.00	10.00	●
0.950	3.000	38.00	10.00	●
0.960	3.000	38.00	10.00	●
0.970	3.000	38.00	10.00	●
0.980	3.000	38.00	10.00	●
0.990	3.000	38.00	10.00	●
1.000	3.000	38.00	10.00	●
1.100	3.000	38.00	10.00	●
1.110	3.000	38.00	10.00	●
1.150	3.000	38.00	10.00	●
1.200	3.000	38.00	10.00	●
1.210	3.000	38.00	10.00	●
1.400	3.000	38.00	10.00	●
1.450	3.000	38.00	10.00	●
1.500	3.000	38.00	10.00	●
1.510	3.000	38.00	10.00	●

Intermediate sizes available.

○ bright (A) TiAlN (A) AlTiN (T) TiN

HARTNER

Micro-precision drills without oil feed



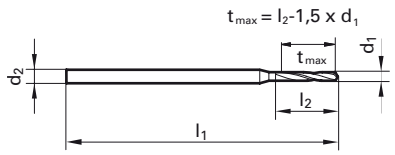
				86402
				Solid carbide
				102
				right-hand
				N
				A
d1	d2	l1	l2	Availability
mm	mm	mm	mm	
1.520	3.000	38.00	10.00	●
1.550	3.000	38.00	10.00	●
1.600	3.000	38.00	12.00	●
1.650	3.000	38.00	12.00	●
1.700	3.000	38.00	12.00	●
1.800	3.000	38.00	12.00	●
1.810	3.000	38.00	12.00	●
1.830	3.000	38.00	12.00	●
1.850	3.000	38.00	12.00	●
1.900	3.000	38.00	12.00	●
1.920	3.000	38.00	12.00	●
1.950	3.000	38.00	12.00	●
1.980	3.000	38.00	12.00	●
2.000	3.000	38.00	12.00	●
2.050	3.000	38.00	12.00	●
2.100	3.000	38.00	12.00	●
2.400	3.000	38.00	12.00	●
2.500	3.000	38.00	12.00	●
2.600	3.000	38.00	12.00	●
2.750	3.000	38.00	12.00	●
2.950	3.000	38.00	12.00	●
3.000	3.000	38.00	12.00	●

Intermediate sizes available.

○ bright (A) TiAlN (A) AlTiN (T) TiN

HARTNER

Micro-precision drills without oil feed



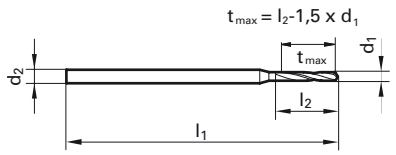
	89286
	Solid carbide
	102
	right-hand
	N
	◯
d1 mm / d2 mm / l1 mm / l2 mm	Availability
0.500 / 0.500 / 38.00 / 8.50	●
0.600 / 0.600 / 38.00 / 9.50	●
0.650 / 0.650 / 38.00 / 10.50	●
0.700 / 0.700 / 38.00 / 10.50	●
0.750 / 0.750 / 38.00 / 12.50	●
0.800 / 0.800 / 38.00 / 12.50	●
0.850 / 0.850 / 38.00 / 14.50	●
0.900 / 0.900 / 38.00 / 14.50	●
1.000 / 1.000 / 38.00 / 17.00	●
1.050 / 1.050 / 38.00 / 17.00	●
1.100 / 1.100 / 38.00 / 17.00	●
1.400 / 1.400 / 38.00 / 17.00	●
1.450 / 1.450 / 38.00 / 17.00	●

Intermediate sizes available.

◯ bright (A) TiAlN (A) AlTiN (T) TiN

HARTNER

Micro-precision drills without oil feed 4 x D



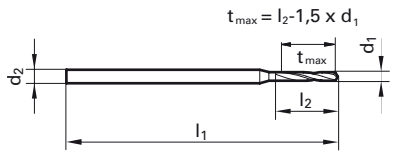
				86400
				Solid carbide
				164
				right-hand
				N
				A
d1	d2	l1	l2	Availability
mm	mm	mm	mm	
0.500	3.000	47.00	3.00	●
0.550	3.000	47.00	3.30	●
0.600	3.000	47.00	3.60	●
0.650	3.000	47.00	3.90	●
0.700	3.000	47.00	4.20	●
0.750	3.000	47.00	4.50	●
0.800	3.000	47.00	4.80	●
0.850	3.000	47.00	5.10	●
0.900	3.000	47.00	5.40	●
0.950	3.000	47.00	5.70	●
1.000	3.000	47.00	6.00	●
1.050	3.000	47.00	6.30	●
1.100	3.000	47.00	6.60	●
1.150	3.000	47.00	6.90	●
1.200	3.000	47.00	7.20	●
1.250	3.000	47.00	7.50	●
1.300	3.000	47.00	7.80	●
1.350	3.000	47.00	8.10	●
1.400	3.000	47.00	8.40	●
1.450	3.000	47.00	8.70	●
1.500	3.000	47.00	9.00	●
1.550	3.000	47.00	9.30	●
1.590	3.000	47.00	9.60	●
1.600	3.000	47.00	9.60	●
1.650	3.000	47.00	9.90	●
1.700	3.000	47.00	10.20	●
1.750	3.000	47.00	10.50	●
1.800	3.000	52.00	10.80	●
1.850	3.000	52.00	11.10	●
1.900	3.000	52.00	11.40	●
1.950	3.000	52.00	11.70	●
1.980	4.000	59.00	12.00	●
2.000	4.000	59.00	12.00	●
2.050	4.000	59.00	12.30	●
2.100	4.000	59.00	12.60	●
2.150	4.000	59.00	12.90	●
2.200	4.000	59.00	13.20	●
2.250	4.000	59.00	13.50	●
2.300	4.000	59.00	13.80	●
2.350	4.000	59.00	14.10	●
2.380	4.000	59.00	14.40	●
2.400	4.000	59.00	14.40	●
2.450	4.000	59.00	14.70	●
2.500	4.000	59.00	15.00	●
2.550	4.000	59.00	15.30	●
2.600	4.000	59.00	15.60	●
2.650	4.000	59.00	15.90	●
2.700	4.000	59.00	16.20	●
2.750	4.000	59.00	16.50	●
2.780	4.000	59.00	16.80	●
2.800	4.000	59.00	16.80	●
2.850	4.000	59.00	17.10	●
2.900	4.000	59.00	17.40	●
2.950	4.000	59.00	17.70	●
3.000	4.000	59.00	18.00	●

Intermediate sizes available.

○ bright (A) TiAlN (A) AlTiN (T) TiN

HARTNER

Micro-precision drills without oil feed 7 x D



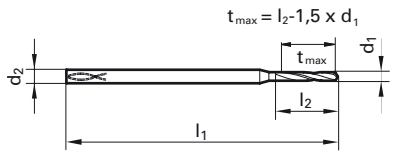
d1 mm	d2 mm	l1 mm	l2 mm	86401 Solid carbide 164 right-hand N A Availability
0.500	3.000	47.00	4.00	●
0.550	3.000	47.00	4.40	●
0.600	3.000	47.00	4.80	●
0.650	3.000	47.00	5.20	●
0.700	3.000	47.00	5.60	●
0.750	3.000	47.00	6.00	●
0.800	3.000	47.00	6.40	●
0.850	3.000	47.00	6.80	●
0.900	3.000	47.00	7.20	●
0.950	3.000	47.00	7.60	●
1.000	3.000	47.00	8.00	●
1.050	3.000	47.00	8.40	●
1.100	3.000	47.00	8.80	●
1.150	3.000	47.00	9.20	●
1.200	3.000	52.00	10.80	●
1.250	3.000	52.00	11.30	●
1.300	3.000	52.00	11.70	●
1.350	3.000	52.00	12.20	●
1.400	3.000	52.00	12.60	●
1.450	3.000	52.00	13.10	●
1.500	3.000	52.00	13.50	●
1.550	3.000	52.00	14.00	●
1.590	3.000	52.00	14.40	●
1.600	3.000	52.00	14.40	●
1.650	3.000	52.00	14.90	●
1.700	3.000	52.00	15.30	●
1.750	3.000	52.00	15.80	●
1.800	3.000	52.00	16.20	●
1.850	3.000	52.00	16.70	●
1.900	3.000	52.00	17.10	●
1.950	3.000	52.00	17.60	●
1.980	4.000	63.00	18.00	●
2.000	4.000	63.00	18.00	●
2.050	4.000	63.00	18.50	●
2.100	4.000	63.00	18.90	●
2.150	4.000	63.00	19.40	●
2.200	4.000	63.00	19.80	●
2.250	4.000	63.00	20.30	●
2.300	4.000	63.00	20.70	●
2.350	4.000	63.00	21.20	●
2.380	4.000	63.00	21.60	●
2.400	4.000	63.00	21.60	●
2.450	4.000	63.00	22.10	●
2.500	4.000	63.00	22.50	●
2.550	4.000	63.00	23.00	●
2.600	4.000	67.00	23.40	●
2.650	4.000	67.00	23.90	●
2.700	4.000	67.00	24.30	●
2.750	4.000	67.00	24.80	●
2.780	4.000	67.00	25.20	●
2.800	4.000	67.00	25.20	●
2.850	4.000	67.00	25.70	●
2.900	4.000	67.00	26.10	●
2.950	4.000	67.00	26.60	●
3.000	4.000	67.00	27.00	●

Intermediate sizes available.

○ bright (A) TiAlN (A) AlTiN (T) TiN

HARTNER

Micro-precision drills with oil feed 5 x D



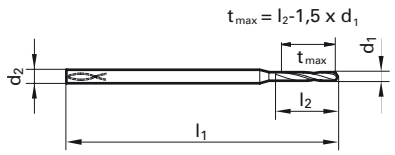
	86405
	Solid carbide
	164
	right-hand
	N
	A
	NEW
d1 mm	Availability
1.400	●
1.450	●
1.500	●
1.550	●
1.590	●
1.600	●
1.650	●
1.700	●
1.750	●
1.800	●
1.850	●
1.900	●
1.950	●
1.980	●
2.000	●
2.050	●
2.100	●
2.150	●
2.200	●
2.250	●
2.300	●
2.350	●
2.380	●
2.400	●
2.450	●
2.500	●
2.550	●
2.600	●
2.650	●
2.700	●
2.750	●
2.780	●
2.800	●
2.850	●
2.900	●
2.950	●
3.000	●

d1 mm	d2 mm	l1 mm	l2 mm
1.400	4.000	52.00	11.00
1.450	4.000	52.00	12.00
1.500	4.000	52.00	12.00
1.550	4.000	52.00	12.00
1.590	4.000	52.00	13.00
1.600	4.000	52.00	13.00
1.650	4.000	52.00	13.00
1.700	4.000	56.00	14.00
1.750	4.000	56.00	14.00
1.800	4.000	56.00	14.00
1.850	4.000	56.00	15.00
1.900	4.000	56.00	15.00
1.950	4.000	56.00	16.00
1.980	4.000	56.00	16.00
2.000	4.000	56.00	16.00
2.050	4.000	56.00	16.00
2.100	4.000	62.00	17.00
2.150	4.000	62.00	17.00
2.200	4.000	62.00	18.00
2.250	4.000	62.00	18.00
2.300	4.000	62.00	18.00
2.350	4.000	62.00	19.00
2.380	4.000	62.00	19.00
2.400	4.000	62.00	19.00
2.450	4.000	62.00	20.00
2.500	4.000	62.00	20.00
2.550	4.000	62.00	20.00
2.600	4.000	66.00	21.00
2.650	4.000	66.00	21.00
2.700	4.000	66.00	22.00
2.750	4.000	66.00	22.00
2.780	4.000	66.00	22.00
2.800	4.000	66.00	22.00
2.850	4.000	66.00	23.00
2.900	4.000	66.00	23.00
2.950	4.000	66.00	24.00
3.000	4.000	66.00	24.00

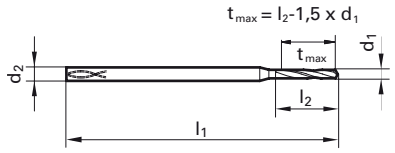
Intermediate sizes available.

○ bright (A) TiAlN (A) AlTiN (T) TiN

Micro-precision drills with oil feed 8 x D/15 x D



	86408
	Solid carbide
	164
	right-hand
	N
	A
d1 mm / d2 mm / l1 mm / l2 mm	Availability
1.400 / 4.000 / 52.00 / 15.00	●
1.500 / 4.000 / 52.00 / 17.00	●
1.600 / 4.000 / 52.00 / 18.00	●
1.700 / 4.000 / 56.00 / 19.00	●
1.800 / 4.000 / 56.00 / 20.00	●
1.900 / 4.000 / 56.00 / 21.00	●
2.000 / 4.000 / 56.00 / 22.00	●
2.100 / 4.000 / 62.00 / 23.00	●
2.200 / 4.000 / 62.00 / 24.00	●
2.300 / 4.000 / 62.00 / 25.00	●
2.400 / 4.000 / 62.00 / 26.00	●
2.500 / 4.000 / 62.00 / 28.00	●
2.600 / 4.000 / 66.00 / 29.00	●
2.700 / 4.000 / 66.00 / 30.00	●
2.800 / 4.000 / 66.00 / 31.00	●
2.900 / 4.000 / 66.00 / 32.00	●
3.000 / 4.000 / 66.00 / 33.00	●



	86412
	Solid carbide
	164
	right-hand
	N
	A
d1 mm / d2 mm / l1 mm / l2 mm	Availability
1.400 / 4.000 / 62.00 / 25.00	●
1.500 / 4.000 / 62.00 / 27.00	●
1.600 / 4.000 / 62.00 / 29.00	●
1.700 / 4.000 / 70.00 / 31.00	●
1.800 / 4.000 / 70.00 / 32.00	●
1.900 / 4.000 / 70.00 / 34.00	●
2.000 / 4.000 / 70.00 / 36.00	●
2.100 / 4.000 / 78.00 / 38.00	●
2.200 / 4.000 / 78.00 / 40.00	●
2.300 / 4.000 / 78.00 / 42.00	●
2.400 / 4.000 / 78.00 / 44.00	●
2.500 / 4.000 / 78.00 / 45.00	●
2.600 / 4.000 / 87.00 / 47.00	●
2.700 / 4.000 / 87.00 / 48.00	●
2.800 / 4.000 / 87.00 / 50.00	●
2.900 / 4.000 / 87.00 / 52.00	●
3.000 / 4.000 / 87.00 / 54.00	●

Intermediate sizes available.

○ bright (A) TiAlN (A) AlTiN (T) TiN

HARTNER

Recommendations

NEW
now 5xD with IC

Pilot drilling

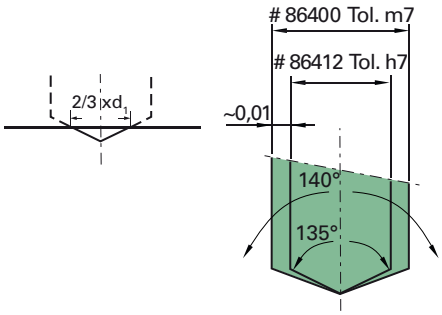
For the application of solid carbide micro precision drills 15xD we recommend a pilot hole 1xD up to 2xD depth. For this pilot hole, the solid carbide micro precision drill 4xD is optimally suitable. Its point angle and its diameter tolerance are perfectly adapted.

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.

Centering

In order to achieve full performance with solid carbide micro precision drills from 8xD drilling depth, we recommend centering. The solid carbide micro precision drill up to 4xD, Hartner no. 86400, can be applied for this purpose. The centering diameter should be approximately 2/3xD.



Drill Ø mm	Feed column no. 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

☒ with external cooling
■ with internal cooling

Drill Ø mm	Feed column no. for art. no. 86400/86401/86402/86405/86408/86412 56	57	58	59	60	61	62	63	64	65	66	67	68
	f (mm/rev.)												
0.50	0.006	0.012	0.018	0.022	0.030	0.035	0.040	0.045	0.050	0.050	0.055	0.060	0.060
0.80	0.008	0.016	0.024	0.032	0.040	0.050	0.060	0.070	0.080	0.080	0.080	0.090	0.090
1.00	0.012	0.022	0.032	0.042	0.060	0.070	0.080	0.090	0.100	0.100	0.110	0.110	0.120
1.50	0.021	0.036	0.051	0.066	0.090	0.100	0.120	0.130	0.150	0.150	0.160	0.170	0.180
2.00	0.032	0.052	0.072	0.092	0.120	0.140	0.160	0.180	0.200	0.210	0.220	0.230	0.240
2.50	0.045	0.070	0.095	0.120	0.150	0.170	0.200	0.220	0.250	0.260	0.270	0.280	0.300
3.00	0.060	0.090	0.120	0.150	0.180	0.210	0.240	0.270	0.300	0.310	0.330	0.340	0.360

STOP

All drilling tools from 8xD must be guided during spot drilling. They must never operate at full speed without support in the machine shop

Material	Material example *Figures in bold = material no. to DIN EN 10 027*	Tens. strength MPa N/mm²	Hardness
Common structural steels	**1.0035** S185, **1.0486** StE P275N, **1.0345** P235GH, **1.0425** P265GH	≤500	
	1.0050 E295, **1.0070** E360, **1.8937** P500NH	>500-850	
Free-cutting steels	**1.0718** 11SMnPb30, **1.0736** 115Mn37	≤850	
	1.0727 46 S20, **1.0728** 60 S20, **1.0757** 46SPb20	850-1000	
Unalloyed heat-treatable steels	**1.0402** C22, **1.1178** C30E	≤ 700	
	1.0503 C45, **1.1191** C45E	700-850	
	1.0601 C60, **1.1221** C60E	850-1000	
Alloyed heat-treatable steels	**1.5131** 50MnSi4, **1.7003** 38Cr2, **1.7030** 28Cr4	850-1000	
	1.5710 36NiCr6, **1.7035** 41Cr4, **1.7225** 42CrMo4	1000-1200	
Unalloyed case hardened steels	**1.0301** C10, **1.1121** C10E	≤750	
Alloyed case hardened steels	**1.7043** 38Cr4	850-1000	
	1.5752 14NiCr14, **1.7131** 16MnCr5, **1.7264** 20CrMo5	1000-1200	
Nitriding steels	**1.8504** 34CrAl6	≥850-1000	
	1.8519 31CrMoV9, **1.8550** 34CrAlNi7	1000-1200	
Tool steels	**1.1750** C75W, **1.2067** 102Cr6, **1.2307** 29CrMoV9	≤850	
	1.2080 X210Cr12, **1.2083** X42Cr13, **1.2419** 105WCr6, **1.2767** X45NiCrMo4	850-1000	
High speed steels	**1.3243** S 6-5-2-5, **1.3343** S 6-5-2, **1.3344** 61CrV4	≥650-1000	
Spring steels	**1.5026** 55Si7, **1.7176** 55Cr3, **1.8159** 51CrV4		≤330 HB
Stainless steels, sulphured	**1.4005** X12CrS13, **1.4104** X14CrMoS17, **1.4105** X6CrMoS17, **1.4305** X8CrNiS18 9	≤850	
austenitic	**1.4301** X5CrNi18 10, **1.4541** X6CrNiTi18 10, **1.4571** X6CrNiMoTi 17 12 2	≤850	
martensitic	**1.4057** X17CrNi16-1, **1.4122** X39CrMo17-1, **1.4521** X2CrMoTi18 2	≤850	
Hardened steels	–		≤40-48 HRC
			>48-60 HRC
Special alloys	Nimonic, Inconel, Monel, Hastelloy	≤1200	
Cast iron	EN-GJL-100 ... EN-GJL-200 (bisher GG10 ... GG20)		≤240 HB
	EN-GJL-250 ... EN-GJL-350 (bisher GG25 ... GG45)		<300 HB
Spheroidal graphite and	EN-GJMW-350-4, EN-GJMB-550-4, EN-GJS-500-7 (bisher GTW35, GTS55, GGG50)		≤240 HB
malleable cast iron	EN-GJMB-700-2, EN-GJS-700-2 (bisher GTW65, GTS70, GGG70)		<300 HB
Chilled cast iron	–		≤350 HB
Ti and Ti-alloys	**3.7024** Ti99,5, **3.7114** TiAl5Sn2,5, **3.7124** TiCu2	≤850	
	3.7154 TiAl6Zr5, **3.7164** TiAl6V4, **3.7184** TiAl4Mo4Sn2,5, - TiAl8Mo1V1	850-1200	
Aluminium and Al-alloys	**3.0255** Al99,5, **3.2315** AlMgSi1, **3.3515** AlMg1	≤400	
Al wrought alloys	**3.0615** AlMgSiPb, **3.1325** AlCuMg1, **3.3245** AlMg3Si, **3.4365** AlZnMgCu1,5	≤450	
Al cast iron ≤ 10 % Si	**3.2131** G-AlSi5Cu1, **3.2153** G-AlSi7Cu3, **3.2573** G-AlSi9	≤600	
> 10 % Si	**3.2581** G-AlSi12, **3.2583** G-AlSi12Cu, - G-AlSi12CuNiMg	≤600	
Magnesium alloys	MgMn2, G-MgAl8Zn1, G-MgAl6Zn3	≤450	
Copper, low-alloyed	**2.0070** SE-Cu, **2.1020** CuSn6, **2.1096** G-CuSn5ZnPb	≤400	
Brass, short-chipping	**2.0380** CuZn39Pb2, **2.0401** CuZn39Pb3, **2.0410** CuZn43Pb2	≤600	
long-chipping	**2.0250** CuZn20, **2.0280** CuZn33, **2.0332** CuZn37Pb0,5	≤600	
Bronze, short-chipping	**2.1090** CuSn7ZnPb, **2.1170** CuPb5Sn5, **2.1176** CuPb10Sn	≤600	
	2.0790 CuNi18Zn19Pb	>600-850	
Bronze, long-chipping	**2.0916** CuAl5, **2.0960** CuAl9Mn, **2.1050** CuSn10	≤850	
	2.0980 CuAl11Ni, **2.1247** CuBe2	850-100	
Duroplastics	Bakelit, Resopal, Pertinax, Moltopren		–
Thermoplastics	Plexiglass, Hostalen, Novodur, Makralon		–
Kevlar	Kevlar		–
Glass, carbon concent. plastics	GFK/CFK		–

○ bright (A) TiAlN (A) AlTiN (T) TiN

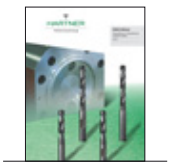
HARTNER

Tool material	HSS-E-PM		HSS-E-PM	Sol. carb.	Sol. carb.	Sol. carb.	Solid carbide		Solid carbide		
Surface finish	○	○	Ⓣ	○	Ⓐ	○	Ⓐ	Ⓐ	Ⓐ	Ⓐ	Ⓐ
Cooling	☒	☒	☒	☒	☒	☒	☒	☒	■	■	■
Drilling depth						~ 10 x D	~ 4 x D	~ 7 x D	~ 5 x D	~ 8 x D	~ 15 x D
Article no.	**87011**	**87016**	**84810**	**89281**	**86402**	**89286**	**86400**	**86401**	**86405**	**86408**	**86412**

v_c m/min	Feed column no.	v_c m/min	Feed column 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 column no.		v_c m/min	Feed column no.		
21	106	*27*	106	*50*	105	*100*	**62**			*100*	**64**	**62**	*105*	**62**	**58**	**58**
18	105	*23*	105	*35*	104	*100*	**62**			*100*	**64**	**62**	*100*	**62**	**58**	**58**
18	106	*23*	106	*50*	**105**	*100*	**62**			*100*	**64**	**62**	*105*	**62**	**59**	**59**
16	105	*21*	105	*45*	**104**	*90*	**61**			*90*	**63**	**61**	*90*	**61**	**59**	**59**
20	105	*26*	105	*45*	104	*90*	**62**			*90*	**64**	**62**	*95*	**62**	**58**	**58**
18	105	*23*	105	*35*	104	*90*	**62**			*90*	**64**	**62**	*95*	**62**	**58**	**58**
14	**104**	*18*	**104**	*30*	103	*90*	**61**			*90*	**63**	**61**	*90*	**61**	**58**	**58**
14	**104**	*18*	**104**	*30*	103	*90*	**61**			*90*	**63**	**61**	*90*	**61**	**58**	**58**
12	103	*16*	103			*70*	**60**			*70*	**62**	**60**	*70*	**60**	**58**	**58**
18	106	*23*	106	*50*	103	*100*	**61**			*100*	**63**	**61**	*100*	**61**	**57**	**57**
14	**104**	*18*	**104**	*40*	103	*85*	**61**			*85*	**63**	**61**	*85*	**61**	**58**	**58**
12	103	*16*	103			*70*	**60**			*70*	**62**	**60**	*70*	**60**	**58**	**58**
14	**104**	*18*	**104**	*25*	103	*70*	**60**			*70*	**62**	**60**	*70*	**60**	**57**	**57**
12	103	*16*	103			*60*	**60**			*60*	**62**	**60**	*60*	**60**	**57**	**57**
16	**104**	*20*	**104**	*25*	103	*50*	**60**			*50*	**62**	**60**	*50*	**60**	**58**	**58**
14	103	*18*	103			*60*	**60**			*60*	**62**	**60**	*50*	**60**	**58**	**58**
14	103	*18*	103							*60*	**57**	**57**	*50*	**57**	**57**	**57**
108	102	*10*	102	*20*	102					*60*	57	57	*50*	57	57	57
106	104	*108*	104	*25*	**103**					*30*	**57**	**57**	*70*	**57**	**57**	**57**
106	103	*108*	103	*25*	**102**					*15*	**56**	**56**	*60*	**56**	**56**	**56**
106	103	*108*	103	*25*	**102**					*30*	**57**	**57**	*70*	**57**	**57**	**57**
				15	104											
				15	**103**					*10*	56	56	*25*	56	56	56
26	106	*33*	106	*80*	**105**	*130*	**66**			*<150*	**68**	**66**	*<150*	**60**	**60**	**60**
22	**106**	*28*	**106**	*60*	**105**	*130*	**66**			*<140*	**68**	**66**	*<140*	**60**	**60**	**60**
18	106	*23*	106	*60*	105	*130*	**66**			*<140*	**68**	**66**	*<140*	**60**	**60**	**60**
22	**106**	*28*	**106**	*50*	**105**	*120*	**65**			*<130*	**67**	**65**	*<130*	**60**	**60**	**60**
				45	**104**					*15*	56	56	*35*	56	56	56
				25	**104**					*15*	56	56	*35*	56	56	56
				160	**107**					*70*	68	68	*70*	68	68	68
				150	**106**					*70*	68	68	*70*	68	68	68
26	107	*33*	107	*100*	**106**					*135*	59	59	*135*	59	59	59
18	106	*23*	106	*60*	**106**					*135*	59	59	*135*	59	59	59
75	106	*97*	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			*50*	**104**							
18	104	*23*	104	*36*	103			*40*	**103**							
				60	104			*80*	**103**							

Our programme:

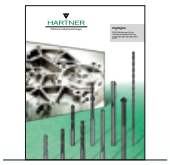
FU 500/FN500



INOX Drills

Micro Precision Drills

TS-Drills



Highlights

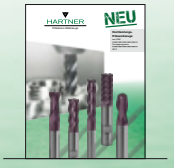
Gun Drills

Multiplex

Multiplex HPC

Standard Range

TM Vending Machines



Solid Carbide
High Performance Milling Cutters

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