

**Micro tools UK  
2012**

## Features



### Application areas

Micro tools are widely used in the model construction, fine mechanical industries with large and small series production as well as for a part in the shapes- and die construction.

The MB tools have as cutting material solid carbide build in a structure with an average grain size of 0.4 to 0.6  $\mu\text{m}$

- => virtually no fracture in  $\mu\text{m}$  dimensions
- => a smooth and tight grinded cutting edge
- => good cutting properties

### High wear resistance on the cutting edge

- => longer form accuracy on the workpiece
- => improved surface roughness

### Editions coated with TiAlN [mono layer] or

AL 66 Nano [multi layer with micro-alloys] for maintaining superior heat hardness

*apply when occurs to early wear on uncoated editions*

- => excellent resistance against oxidation and build up edge
- => long tool live when working in abrasive materials

### Editions with internal coolant channels

- => better and more accurate supply of the coolant flow
- => support on chip removal

### Perfect possibilities in repeatable regrinding and recoating

- => low cost on the tooling by a longer total life cycle of the tools

## Index drills



**805 Series**  
Ø 0.05 - 0.39 mm with 118° drill point  
Ø 0.40 - 1.50 mm met 140° drill point  
2 cutting edges  
30° helix  
DIN 1899 A shank  
P, M, K, N and H workpiece materials



**815 Series**  
Ø 0.05 - 0.39 mm with 118° drill point  
Ø 0.40 - 3.00 mm with 140° drill point  
2 cutting edges  
30° helix  
Reinforced shank  
P, M, K, N and H workpiece materials



**840 Series**  
Ø 0.80 - 3.00 mm for 4 x D drill depth  
2 cutting edges  
140° drill point; self centering  
30° helix  
DIN 6535 HA shank  
P, M, K, N and H workpiece materials



**870 Series**  
Ø 0.80 - 3.00 for 7 x D drill depth  
2 cutting edges  
140° drill point; self centering  
30° helix  
DIN 6535 HA shank  
P, M, K, N and H workpiece materials



**833 Series [internal coolant supply]**  
Ø 1.00 - 2.90 mm for 3 x D drill depth  
2 cutting edges  
140° drill point; self centering  
30° helix  
DIN 6535 HA shank  
P, M, K, N and H workpiece materials



**851 Series [internal coolant supply]**  
Ø 1.00 - 2.90 mm for 5 x D drill depth  
2 cutting edges  
140° drill point; self centering  
30° helix  
DIN 6535 HA shank  
P, M, K, N and H workpiece materials



**881 Series [internal coolant supply]**  
Ø 1.00 - 2.90 mm for 8 x D drill depth  
2 Schneiden  
140° drill point; self centering  
30° helix  
DIN 6535 HA shank  
P, M, K, N and H workpiece materials



**812 Series [internal coolant supply]**  
Ø 1.00 - 2.90 mm for 12 x D drill depth  
2 cutting edges  
140° drill point; self centering  
30° helix  
DIN 6535 HA shank  
P, M, K, N and H workpiece materials



**832 Series**  
Ø 0.60 - 12.50 mm extra short edition  
3 cutting edges  
120° drill point  
30° helix  
DIN 6539 HA shank  
P, M, K, N and H workpiece materials



**834 K Series**  
Ø 1.00 - 8.50 mm short edition  
3 cutting edges  
140° drill point; self centering  
35° helix  
DIN 6535 HA shank  
P, M, K, N and H workpiece materials

## Index drills



**834 L Series**  
1.00 - 8.50 mm long edition  
3 cutting edges  
140° drill point; self centering  
35° helix  
DIN 6539 HA shank  
P, M, K, N and H workpiece materials



**835 Series**  
Ø 0.70 - 8.50 mm DIN 338  
2 cutting edges  
120° drill point  
24° helix  
DIN 6535 HA shank  
P, M, K, N and H workpiece materials

## Complementary tools like center drills, reamers, end mills and engraving spikes



**810 en 812 Series center drills**  
Ø 0.05 - 0.09 mm [tol. - 0.005 / - 0.10 mm]  
Ø 0.10 - 3.0 mm [tol. - 0.01 / - 0.015 mm]  
Drill points 90° en 120°  
2 cutting edges  
24° helix  
DIN 6535 HA shank  
P, M, K and N workpiece materials



**R2 Series reamers**  
Ø 0.900 - 12.150 mm [tol. +/- 0.002 mm]  
45° T - land  
3 - 6 cutting edges  
Straight chip flutes  
DIN 6535 HA shank  
P, M, K, N and H workpiece materials



**R3 Series reamers [internal coolant supply]**  
Ø 0.900 - 12.150 mm [tol. +/- 0.002 mm]  
45° T p land  
3 - 6 cutting edges  
Straight chip flutes  
DIN 6535 HA shank  
P, M, K, N and H workpiece materials



**R2 2S Series reamers**  
Ø 3.00 - 8.00 mm [tol. h7]  
45° T - land  
2 cutting edges  
Straight chip flutes  
DIN 6535 HA shank  
P, M, K, N and H workpiece materials



**241 Series 1 cutting edge end mill**  
Ø 0.10 - 12.00 mm  
1 cutting edge  
30° helix  
DIN 6535 HA shank  
P, M and N workpiece materials

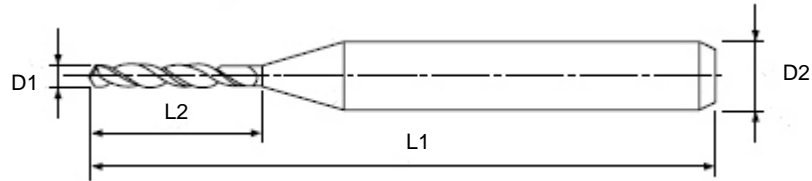


**847 Series engraving spikes**  
Ø 2.00 - 8.00 mm  
0.2 mm [tol. +/- 0.05] edge preparation on the cutting edge  
1 cutting edge with engraving angles of  
30°, 45°, 60° or 90°  
Straight chip flute  
DIN 6535 HA shank  
K, N and H workpiece materials

Technical data



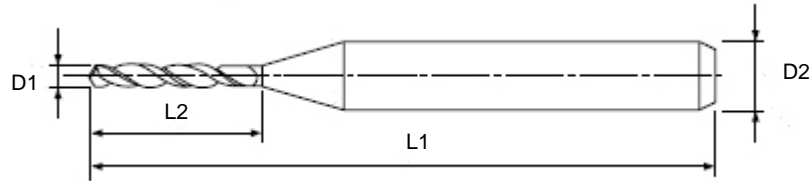
**805 Series**  
 Ø 0.05 - 0.39 mm with 118° drill point  
 Ø 0.40 - 1.50 mm with 140° drill point  
 2 cutting edges  
 30° helix  
 DIN 1899 A shank [h6]  
 Uncoated, TiAlN and Al66Nano editions



Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
805 005	0.05	0.7	1.00	25	12.30	14.10	14.60
805 008	0.08	0.7	1.00	25	12.30	14.10	14.60
805 009	0.09	0.7	1.00	25	9.20	11.00	11.40
805 010	0.10	0.7	1.00	25	6.30	8.10	8.60
805 011	0.11	0.7	1.00	25	6.30	8.10	8.60
805 012	0.12	0.7	1.00	25	6.30	8.10	8.60
805 013	0.13	1.0	1.00	25	6.30	8.10	8.60
805 014	0.14	1.0	1.00	25	6.30	8.10	8.60
805 015	0.15	1.0	1.00	25	6.30	8.10	8.60
805 016	0.16	1.4	1.00	25	6.30	8.10	8.60
805 017	0.17	1.4	1.00	25	6.30	8.10	8.60
805 018	0.18	1.4	1.00	25	6.30	8.10	8.60
805 019	0.19	1.4	1.00	25	6.30	8.10	8.60
805 020	0.20	1.8	1.00	25	4.70	6.50	7.00
805 021	0.21	1.8	1.00	25	4.70	6.50	7.00
805 022	0.22	1.8	1.00	25	4.70	6.50	7.00
805 023	0.23	1.8	1.00	25	4.70	6.50	7.00
805 024	0.24	1.8	1.00	25	4.70	6.50	7.00
805 025	0.25	2.2	1.00	25	4.70	6.50	7.00
805 026	0.26	2.2	1.00	25	4.70	6.50	7.00
805 027	0.27	2.2	1.00	25	4.70	6.50	7.00
805 028	0.28	2.2	1.00	25	4.70	6.50	7.00
805 029	0.29	2.2	1.00	25	4.70	6.50	7.00
805 030	0.30	2.2	1.00	25	4.70	6.50	7.00
805 031	0.31	2.8	1.00	25	4.70	6.50	7.00
805 032	0.32	2.8	1.00	25	4.70	6.50	7.00
805 033	0.33	2.8	1.00	25	4.70	6.50	7.00
805 034	0.34	2.8	1.00	25	4.70	6.50	7.00
805 035	0.35	2.8	1.00	25	4.70	6.50	7.00
805 036	0.36	2.8	1.00	25	4.70	6.50	7.00
805 037	0.37	2.8	1.00	25	4.70	6.50	7.00
805 038	0.38	2.8	1.00	25	4.70	6.50	7.00



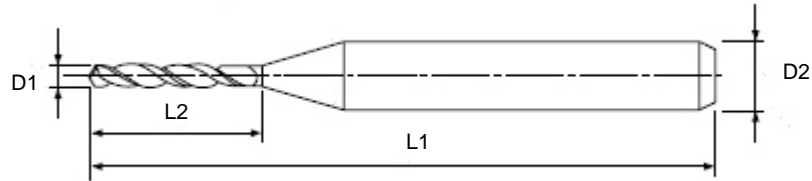
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Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
805 039	0.39	3.6	1.00	25	4.70	6.50	7.00
805 040	0.40	3.6	1.00	25	4.70	6.50	7.00
805 041	0.41	3.6	1.00	25	4.70	6.50	7.00
805 042	0.42	3.6	1.00	25	4.70	6.50	7.00
805 043	0.43	3.6	1.00	25	4.70	6.50	7.00
805 044	0.44	3.6	1.00	25	4.70	6.50	7.00
805 045	0.45	3.6	1.00	25	4.70	6.50	7.00
805 046	0.46	3.6	1.00	25	4.70	6.50	7.00
805 047	0.47	3.6	1.00	25	4.70	6.50	7.00
805 048	0.48	3.6	1.00	25	4.70	6.50	7.00
805 049	0.49	4.0	1.00	25	4.70	6.50	7.00
805 050	0.50	4.0	1.00	25	4.70	6.50	7.00
805 051	0.51	4.0	1.00	25	4.70	6.50	7.00
805 052	0.52	4.0	1.00	25	4.70	6.50	7.00
805 053	0.53	4.0	1.00	25	4.70	6.50	7.00
805 054	0.54	4.5	1.00	25	4.70	6.50	7.00
805 055	0.55	4.5	1.00	25	4.70	6.50	7.00
805 056	0.56	4.5	1.00	25	4.70	6.50	7.00
805 057	0.57	4.5	1.00	25	4.70	6.50	7.00
805 058	0.58	4.5	1.00	25	4.70	6.50	7.00
805 059	0.59	4.5	1.00	25	4.70	6.50	7.00
805 060	0.60	4.5	1.00	25	4.70	6.50	7.00
805 061	0.61	5.0	1.00	25	4.70	6.50	7.00
805 062	0.62	5.0	1.00	25	4.70	6.50	7.00
805 065	0.63	5.0	1.00	25	4.70	6.50	7.00
805 064	0.64	5.0	1.00	25	4.70	6.50	7.00
805 065	0.65	5.0	1.00	25	4.70	6.50	7.00
805 066	0.66	5.0	1.00	25	4.70	6.50	7.00
805 067	0.67	5.0	1.00	25	4.70	6.50	7.00
805 068	0.68	5.6	1.00	25	4.70	6.50	7.00
805 069	0.69	5.6	1.00	25	4.70	6.50	7.00
805 070	0.70	5.6	1.00	25	4.70	6.50	7.00



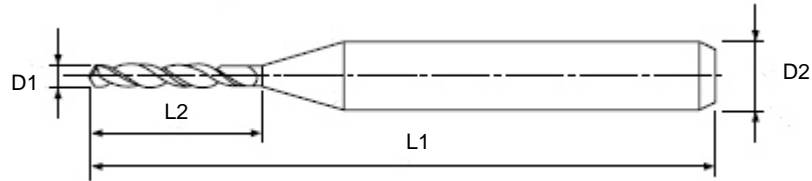
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Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
805 071	0.71	5.6	1.00	25	4.70	6.50	7.00
805 072	0.72	5.6	1.00	25	4.70	6.50	7.00
805 073	0.73	5.6	1.00	25	4.70	6.50	7.00
805 074	0.74	5.6	1.00	25	4.70	6.50	7.00
805 075	0.75	5.6	1.00	25	4.70	6.50	7.00
805 076	0.76	6.3	1.00	25	4.70	6.50	7.00
805 077	0.77	6.3	1.00	25	4.70	6.50	7.00
805 078	0.78	6.3	1.00	25	4.70	6.50	7.00
805 079	0.79	6.3	1.00	25	4.70	6.50	7.00
805 080	0.80	6.3	1.50	25	4.70	6.50	7.00
805 081	0.81	6.3	1.50	25	4.70	6.50	7.00
805 082	0.82	6.3	1.50	25	4.70	6.50	7.00
805 083	0.83	6.3	1.50	25	4.70	6.50	7.00
805 084	0.84	6.3	1.50	25	4.70	6.50	7.00
805 085	0.85	6.3	1.50	25	4.70	6.50	7.00
805 086	0.86	7.1	1.50	25	4.70	6.50	7.00
805 087	0.87	7.1	1.50	25	4.70	6.50	7.00
805 088	0.88	7.1	1.50	25	4.70	6.50	7.00
805 089	0.89	7.1	1.50	25	4.70	6.50	7.00
805 090	0.90	7.1	1.50	25	4.70	6.50	7.00
805 091	0.91	7.1	1.50	25	4.70	6.50	7.00
805 092	0.92	7.1	1.50	25	4.70	6.50	7.00
805 093	0.93	7.1	1.50	25	4.70	6.50	7.00
805 094	0.94	7.1	1.50	25	4.70	6.50	7.00
805 095	0.95	7.1	1.50	25	4.70	6.50	7.00
805 096	0.96	8.0	1.50	25	4.70	6.50	7.00
805 097	0.97	8.0	1.50	25	4.70	6.50	7.00
805 098	0.98	8.0	1.50	25	4.70	6.50	7.00
805 099	0.99	8.0	1.50	25	4.70	6.50	7.00
805 100	1.00	8.0	1.50	25	4.70	6.50	7.00
805 105	1.05	8.0	1.50	25	4.70	6.50	7.00
805 110	1.10	9.0	1.50	25	4.70	6.50	7.00



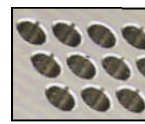
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 2 cutting edges  
 30° helix  
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 Uncoated, TiAlN and Al66Nano editions



Article-number	D1	L2	D2	L1	Price	Price	Prces
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
805 115	1.15	8.0	1.50	25	4.70	6.50	7.00
805 120	1.20	10.0	1.50	25	4.70	6.50	7.00
805 125	1.25	10.0	1.50	25	4.70	6.50	7.00
805 130	1.30	10.0	1.50	25	4.70	6.50	7.00
805 135	1.35	11.2	1.50	25	4.70	6.50	7.00
805 140	1.40	11.2	1.50	25	4.70	6.50	7.00
805 145	1.45	11.2	1.50	25	4.70	6.50	7.00
805 150	1.50	11.2	1.50	25	4.70	6.50	7.00

**Machining example**

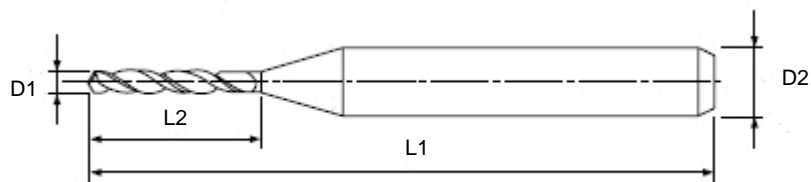
Worrkpiece: heat exchange plate  
 Material: stainless steel 304 DIN 1.4301  
 Operation: hole Ø 0.75 mm; drill depth 3.5 mm  
 Procedure: in steps > 1xD / 0.5xD a.s.o  
 Machining center: vertical  
 Adapter: SK30 MAS-BT/JIS to ER11 collet  
 Coolant: 8% emulsion  
 Tool: 805 075  
 Cutting speed Vc / revolutions n: Vc = 28.3 m/min / n = 12000 r.p.m.  
 Feed rates fn and Vf: fn = 0.008 mm and Vf = 96 mm/min







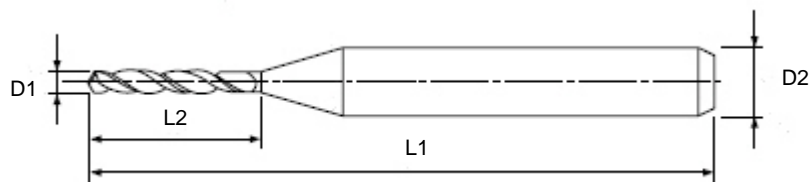
**815 Series**  
 Ø 0.05 - 0.39 mm with 118° drill point  
 Ø 0.40 - 3.00 mm with 140° drill point  
 2 cutting edges  
 30° helix  
 Reinforced shank [h6]  
 Uncoated, TiAlN and Al66Nano



Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
815 005	0.05	0.6	3.00	38	12.40	14.10	14.60
815 008	0.08	0.8	3.00	38	9.30	11.00	11.40
815 009	0.09	1.0	3.00	38	9.30	11.00	11.40
815 010	0.10	1.0	3.00	38	9.30	11.00	11.40
815 011	0.11	1.0	3.00	38	9.30	11.00	11.40
815 012	0.12	1.5	3.00	38	9.30	11.00	11.40
815 013	0.13	1.5	3.00	38	9.30	11.00	11.40
815 014	0.14	1.5	3.00	38	9.30	11.00	11.40
815 015	0.15	1.5	3.00	38	9.30	11.00	11.40
815 016	0.16	1.5	3.00	38	9.30	11.00	11.40
815 017	0.17	1.5	3.00	38	9.30	11.00	11.40
815 018	0.18	2.5	3.00	38	9.30	11.00	11.40
815 019	0.19	2.5	3.00	38	9.30	11.00	11.40
815 020	0.20	2.5	3.00	38	9.30	11.00	11.40
815 021	0.21	2.5	3.00	38	9.30	11.00	11.40
815 022	0.22	2.5	3.00	38	9.30	11.00	11.40
815 023	0.23	4.0	3.00	38	9.30	11.00	11.40
815 024	0.24	4.0	3.00	38	9.30	11.00	11.40
815 025	0.25	4.0	3.00	38	9.30	11.00	11.40
815 026	0.26	4.0	3.00	38	9.30	11.00	11.40
815 027	0.27	4.0	3.00	38	9.30	11.00	11.40
815 028	0.28	4.0	3.00	38	9.30	11.00	11.40
815 029	0.29	4.0	3.00	38	9.30	11.00	11.40
815 030	0.30	5.5	3.00	38	9.30	11.00	11.40
815 031	0.31	5.5	3.00	38	9.30	11.00	11.40
815 032	0.32	5.5	3.00	38	9.30	11.00	11.40
815 033	0.33	5.5	3.00	38	9.30	11.00	11.40
815 034	0.34	5.5	3.00	38	9.30	11.00	11.40
815 035	0.35	5.5	3.00	38	9.30	11.00	11.40
815 036	0.36	5.5	3.00	38	9.30	11.00	11.40
815 037	0.37	5.5	3.00	38	9.30	11.00	11.40
815 038	0.38	5.5	3.00	38	9.30	11.00	11.40



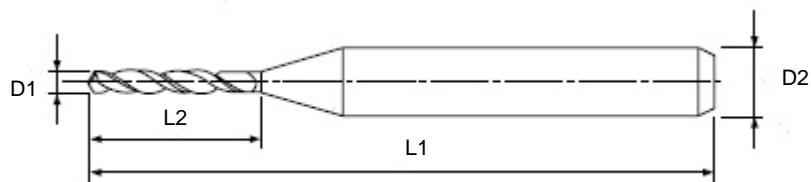
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Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
815 039	0.39	5.5	3.00	38	9.30	11.00	11.40
815 040	0.40	6.0	3.00	38	9.30	11.00	11.40
815 045	0.45	6.0	3.00	38	9.30	11.00	11.40
815 050	0.50	6.0	3.00	38	9.30	11.00	11.40
815 055	0.55	8.0	3.00	38	9.30	11.00	11.40
815 060	0.60	8.0	3.00	38	9.30	11.00	11.40
815 065	0.65	8.0	3.00	38	9.30	11.00	11.40
815 070	0.70	8.0	3.00	38	9.30	11.00	11.40
815 075	0.75	8.0	3.00	38	9.30	11.00	11.40
815 080	0.80	8.0	3.00	38	9.30	11.00	11.40
815 085	0.85	8.0	3.00	38	9.30	11.00	11.40
815 090	0.90	8.0	3.00	38	9.30	11.00	11.40
815 095	0.95	8.0	3.00	38	9.30	11.00	11.40
815 100	1.00	10.0	3.00	38	9.30	11.00	11.40
815 105	1.05	10.0	3.00	38	9.30	11.00	11.40
815 110	1.10	10.0	3.00	38	9.30	11.00	11.40
815 115	1.15	10.0	3.00	38	9.30	11.00	11.40
815 120	1.20	10.0	3.00	38	9.30	11.00	11.40
815 125	1.25	10.0	3.00	38	9.30	11.00	11.40
815 130	1.30	10.0	3.00	38	9.30	11.00	11.40
815 135	1.35	10.0	3.00	38	9.30	11.00	11.40
815 140	1.40	10.0	3.00	38	9.30	11.00	11.40
815 145	1.45	10.0	3.00	38	9.30	11.00	11.40
815 150	1.50	12.0	3.00	38	9.30	11.00	11.40
815 155	1.55	12.0	3.00	38	9.30	11.00	11.40
815 160	1.60	12.0	3.00	38	9.30	11.00	11.40
815 165	1.65	12.0	3.00	38	9.30	11.00	11.40
815 170	1.70	12.0	3.00	38	9.30	11.00	11.40
815 175	1.75	12.0	3.00	38	9.30	11.00	11.40
815 180	1.80	12.0	3.00	38	9.30	11.00	11.40
815 185	1.85	12.0	3.00	38	9.30	11.00	11.40
815 190	1.90	12.0	3.00	38	9.30	11.00	11.40



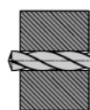
**815 Series**  
 Ø 0.05 - 0.39 mm with 118° drill point  
 Ø 0.40 - 3.00 mm with 140° drill point  
 2 cutting edges  
 30° helix  
 Reinforced shank [h6]  
 Uncoated, TiAlN and Al66Nano



Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
815 195	1.95	12.0	3.00	38	9.30	11.00	11.40
815 200	2.00	12.0	3.00	38	9.30	11.00	11.40
815 205	2.05	12.0	3.00	38	9.30	11.00	11.40
815 210	2.10	12.0	3.00	38	9.30	11.00	11.40
815 215	2.15	12.0	3.00	38	9.30	11.00	11.40
815 220	2.20	12.0	3.00	38	9.30	11.00	11.40
815 225	2.25	12.0	3.00	38	9.30	11.00	11.40
815 230	2.30	12.0	3.00	38	9.30	11.00	11.40
815 235	2.35	12.0	3.00	38	9.30	11.00	11.40
815 240	2.40	12.0	3.00	38	9.30	11.00	11.40
815 245	2.45	12.0	3.00	38	9.30	11.00	11.40
815 250	2.50	12.0	3.00	38	9.30	11.00	11.40
815 255	2.55	12.0	3.00	38	9.30	11.00	11.40
815 260	2.60	12.0	3.00	38	9.30	11.00	11.40
815 265	2.65	12.0	3.00	38	9.30	11.00	11.40
815 270	2.70	12.0	3.00	38	9.30	11.00	11.40
815 275	2.75	12.0	3.00	38	9.30	11.00	11.40
815 280	2.80	12.0	3.00	38	9.30	11.00	11.40
815 285	2.85	12.0	3.00	38	9.30	11.00	11.40
815 290	2.90	12.0	3.00	38	9.30	11.00	11.40
815 295	2.95	12.0	3.00	38	9.30	11.00	11.40
815 300	3.00	12.0	3.00	38	9.30	11.00	11.40

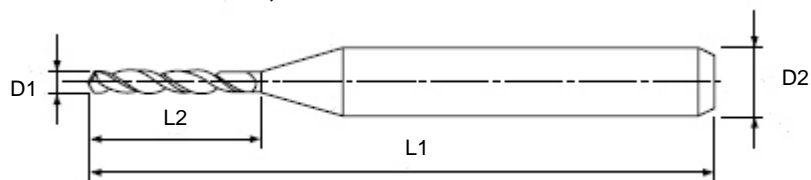
**Machining example**

Workpiece: flange  
 Material: brass CuZn15  
 Operation: hole Ø 2.5 mm; drill depth 8.0 mm  
 Machining center: horizontal  
 Adapter: SK40 MAS-BT/JIS to ER20 collet  
 Coolant: 8% emulsion  
 Tool: 815 250 Al66Nano  
 Cutting speed Vc / revolutions n: Vc = 50.0 m/min / n = 6370 r.p.m.  
 Feed rate fn and Vf: fn = 0.03 mm and Vf = 191 mm/min





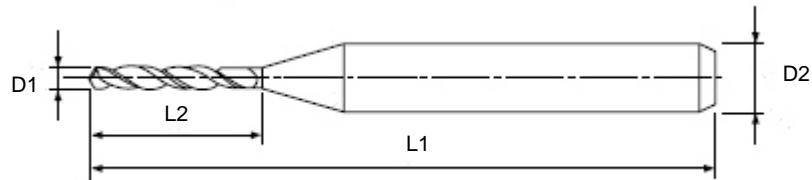
**840 Series**  
**Ø 0.80 - 3.00 mm for 4 x D drill depth**  
**2 cutting edges**  
**140° drill point; self centering**  
**30° helix**  
**DIN 6535 HA shank [h6]**  
**Uncoated, TiAlN and AL66Nano**



Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
840 080	0.80	5.20	3.00	44	26.90	28.60	29.10
840 085	0.85	5.20	3.00	44	26.90	28.60	29.20
840 090	0.90	5.80	3.00	44	26.90	28.60	29.20
840 095	0.95	5.80	3.00	44	26.90	28.60	29.20
840 100	1.10	6.40	3.00	44	26.90	28.60	29.20
840 105	1.05	6.40	3.00	44	26.90	28.60	29.20
840 110	1.10	7.00	3.00	44	26.90	28.60	29.20
840 115	1.15	7.00	3.00	44	26.90	28.60	29.20
840 120	1.20	7.60	3.00	45	26.90	28.60	29.20
840 125	1.25	7.60	3.00	45	26.90	28.60	29.20
840 130	1.30	8.20	3.00	45	26.90	28.60	29.20
840 135	1.35	8.20	3.00	45	26.90	28.60	29.20
840 140	1.40	8.80	3.00	46	26.90	28.60	29.20
840 145	1.45	8.80	3.00	46	26.90	28.60	29.20
840 150	1.50	9.40	3.00	46	26.90	28.60	29.20
840 155	1.55	9.40	3.00	46	26.90	28.60	29.20
840 160	1.60	10.0	3.00	47	26.90	28.60	29.20
840 165	1.65	10.0	3.00	47	26.90	28.60	29.20
840 170	1.70	10.6	3.00	47	26.90	28.60	29.20
840 175	1.75	10.6	3.00	47	26.90	28.60	29.20
840 180	1.80	11.2	3.00	48	26.90	28.60	29.20
840 185	1.85	11.2	3.00	48	26.90	28.60	29.20
840 190	1.90	11.8	3.00	48	26.90	28.60	29.20
840 195	1.95	11.8	3.00	48	26.90	28.60	29.20
840 200	2.00	12.4	3.00	55	26.90	28.60	29.20
840 205	2.05	12.4	3.00	55	32.70	34.40	34.80
840 210	2.10	13.0	3.00	55	32.70	34.40	34.80
840 215	2.15	13.0	3.00	55	32.70	34.40	34.80
840 220	2.20	13.6	3.00	56	32.70	34.40	34.80
840 225	2.25	13.6	3.00	56	32.70	34.40	34.80
840 230	2.30	14.2	3.00	56	32.70	34.40	34.80
840 235	2.35	14.2	3.00	56	32.70	34.40	34.80



**840 Series**  
**Ø 0.80 - 3.00 mm for 4 x D drill depth**  
**2 cutting edges**  
**140° drill point; self centering**  
**30° helix**  
**DIN 6535 HA shank [h6]**  
**Uncoated, TiAlN and AL66Nano**



Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
840 240	2.40	14.60	3.00	57	32.70	34.40	34.80
840 245	2.45	14.60	3.00	57	32.70	34.40	34.80
840 250	2.50	15.20	3.00	57	32.70	34.40	34.80
840 255	2.55	15.20	3.00	57	32.70	34.40	34.80
840 260	2.60	15.80	3.00	58	32.70	34.40	34.80
840 265	2.65	15.80	3.00	58	32.70	34.40	34.80
840 270	2.70	16.40	3.00	58	32.70	34.40	34.80
840 275	2.75	16.40	3.00	58	32.70	34.40	34.80
840 280	2.80	17.00	3.00	60	32.70	34.40	34.80
840 285	2.85	17.00	3.00	60	32.70	34.40	34.80
840 290	2.90	17.60	3.00	60	32.70	34.40	34.80
840 295	2.95	17.60	3.00	60	32.70	34.40	34.80
840 300	3.00	18.00	3.00	60	32.70	34.40	34.80

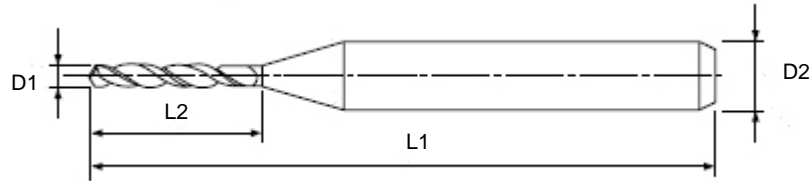
**Machining example**

Workpiece: thread hole [M2 x 0.2] medical instrument  
 Material: pure titanium Gr2  
 Operation: hole diameter Ø 1.8 mm; drill depth 3.0 mm  
 Procedure: in steps > 1xD / 0.5xD a.s.o.  
 B.A.Z.: vertical  
 Adapter: SK40 MAS-BT/JIS to ER20 collet  
 Coolant: 8% emulsion  
 Tool: 840 180  
 Cutting speed Vc / revolutions n: Vc = 28.3 m/min / n = 5000 r.p.m.  
 Feed rate fn and Vf: fn = 0.015 mm and Vf = 75 mm/min





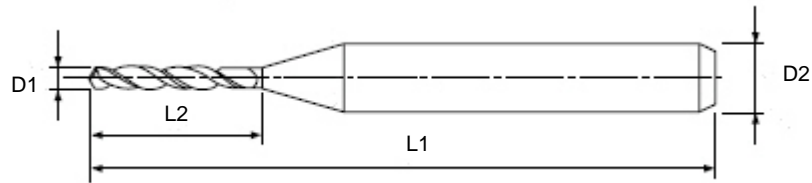
**870 Series**  
**Ø 0.80 - 3.00 for 7 x D drill depth**  
**2 cutting edges**  
**140° drill point; self centering**  
**30° helix**  
**DIN 6535 HA shank [h6]**  
**Uncoated, TiAlN and Al66Nano**



Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
870 080	0.80	6.80	3.00	45	26.90	28.60	29.10
870 085	0.85	6.80	3.00	45	26.90	28.60	29.20
870 090	0.90	7.60	3.00	45	26.90	28.60	29.20
870 095	0.95	7.60	3.00	45	26.90	28.60	29.20
870 100	1.10	8.40	3.00	46	26.90	28.60	29.20
870 105	1.05	8.40	3.00	46	26.90	28.60	29.20
870 110	1.10	9.20	3.00	46	26.90	28.60	29.20
870 115	1.15	9.20	3.00	46	26.90	28.60	29.20
870 120	1.20	11.30	3.00	49	26.90	28.60	29.20
870 125	1.25	11.30	3.00	49	26.90	28.60	29.20
870 130	1.30	12.20	3.00	49	26.90	28.60	29.20
870 135	1.35	12.20	3.00	49	26.90	28.60	29.20
870 140	1.40	13.10	3.00	50.5	26.90	28.60	29.20
870 145	1.45	13.10	3.00	50.5	26.90	28.60	29.20
870 150	1.50	13.50	3.00	50.5	26.90	28.60	29.20
870 155	1.55	13.50	3.00	50.5	26.90	28.60	29.20
870 160	1.60	14.90	3.00	52	26.90	28.60	29.20
870 165	1.65	14.90	3.00	52	26.90	28.60	29.20
870 170	1.70	15.80	3.00	52	26.90	28.60	29.20
870 175	1.75	15.80	3.00	52	26.90	28.60	29.20
870 180	1.80	16.70	3.00	53.5	26.90	28.60	29.20
870 185	1.85	16.70	3.00	53.5	26.90	28.60	29.20
870 190	1.90	17.60	3.00	53.5	26.90	28.60	29.20
870 195	1.95	17.60	3.00	53.5	26.90	28.60	29.20
870 200	2.00	18.50	3.00	61.5	26.90	28.60	29.20
870 205	2.05	18.50	3.00	61.5	32.70	34.40	34.80
870 210	2.10	19.40	3.00	61.5	32.70	34.40	34.80
870 215	2.15	19.40	3.00	61.5	32.70	34.40	34.80
870 220	2.20	20.30	3.00	63	32.70	34.40	34.80
870 225	2.25	20.30	3.00	63	32.70	34.40	34.80
870 230	2.30	21.20	3.00	63	32.70	34.40	34.80
870 235	2.35	21.20	3.00	63	32.70	34.40	34.80



**870 Series**  
 Ø 0.80 - 3.00 for 7 x D drill depth  
 2 cutting edges  
 140° drill point; self centering  
 30° helix  
 DIN 6535 HA shank [h6]  
 Uncoated, TiAlN and Al66Nano



Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
870 240	2.40	22.10	3.00	64.5	32.70	34.40	34.80
870 245	2.45	22.10	3.00	64.5	32.70	34.40	34.80
870 250	2.50	23.00	3.00	64.5	32.70	34.40	34.80
870 255	2.55	23.00	3.00	64.5	32.70	34.40	34.80
870 260	2.60	23.90	3.00	66	32.70	34.40	34.80
870 265	2.65	23.90	3.00	66	32.70	34.40	34.80
870 270	2.70	24.80	3.00	66	32.70	34.40	34.80
870 275	2.75	24.80	3.00	66	32.70	34.40	34.80
870 280	2.80	25.70	3.00	67.5	32.70	34.40	34.80
870 285	2.85	25.70	3.00	67.5	32.70	34.40	34.80
870 290	2.90	26.60	3.00	67.5	32.70	34.40	34.80
870 295	2.95	26.60	3.00	67.5	32.70	34.40	34.80
870 300	3.00	27.20	3.00	67.5	32.70	34.40	34.80

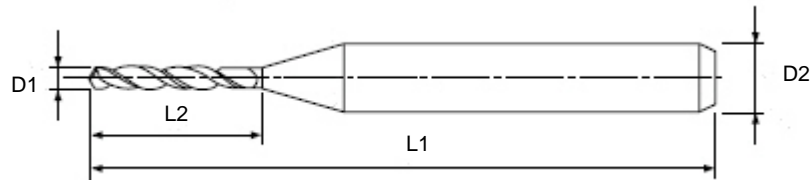
**Machining example**

Workpiece: bearing seat  
 Material: nodular cast iron EN-GJS-400  
 Operation: hole Ø 2.0 mm; drill depth 10.0 mm  
 Procedure: centering with 142° drill point and in steps to final depth > 1xD / 0.5xD  
 Machining center: vertical  
 Adapter: SK40 MAS-BT/JIS to ER20 collet  
 Coolant: 8% emulsion  
 Tool: 840 180 TiAlN  
 Cutting speed Vc / revolutions n: Vc = 50.0 m/min / n = 7960 r.p.m.  
 Feed rates fn and Vf: fn = 0.025 mm and Vf = 199 mm/min





833 Series [internal coolant supply]  
 Ø 1.00 2.90 mm for 3 x D drill depth  
 2 cutting edges  
 140° drill point; self centering  
 30° helix  
 DIN 6535 HA shank [h6]  
 Uncoated, TiAlN and Al66Nano

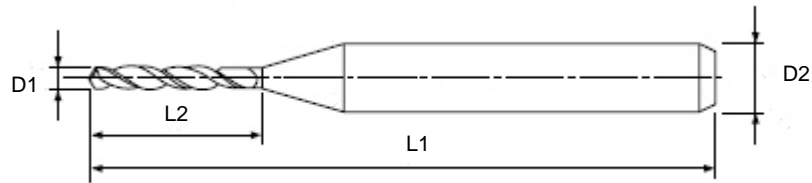


Article-number	D1 [+0.004]	L2	D2	L1	Price	Price	Price
					[in € / piece] uncoated	[in € / piece] TiAlN	[in € / piece] Al66Nano
833 0100	1.00	6	3.00	55	32.10	35.00	35.60
833 0110	1.10	9	3.00	55	32.10	35.00	35.60
833 0120	1.20	9	3.00	55	32.10	35.00	35.60
833 0125	1.25	9	3.00	55	32.10	35.00	35.60
833 0130	1.30	9	3.00	55	32.10	35.00	35.60
833 0135	1.35	9	3.00	55	32.10	35.00	35.60
833 0140	1.40	9	3.00	55	32.10	35.00	35.60
833 0145	1.45	9	3.00	55	32.10	35.00	35.60
833 0150	1.50	9	3.00	68	34.60	37.70	38.20
833 0160	1.60	12	3.00	68	34.60	37.70	38.20
833 0170	1.70	12	3.00	68	34.60	37.70	38.20
833 0180	1.80	12	3.00	68	34.60	37.70	38.20
833 0190	1.90	12	3.00	68	34.60	37.70	38.20
833 0200	2.00	12	3.00	74	34.60	37.70	38.20
833 0210	2.10	15	3.00	74	35.70	38.80	39.30
833 0220	2.20	15	3.00	74	35.70	38.80	39.30
833 0230	2.30	15	3.00	74	35.70	38.80	39.30
833 0240	2.40	15	3.00	74	35.70	38.80	39.30
833 0250	2.50	15	3.00	81	35.70	38.80	39.30
833 0260	2.60	16	3.00	81	35.70	38.80	39.30
833 0270	2.70	16	3.00	81	35.70	38.80	39.30
833 0280	2.80	16	3.00	81	35.70	38.80	39.30
833 0290	2.90	16	3.00	81	35.70	38.80	39.30





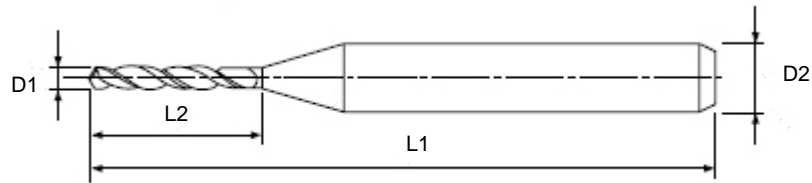
851 Series [central coolant supply]  
 Ø 1.00 2.90 mm for 5 x D drill depth  
 2 cutting edges  
 140° drill point; self centering  
 30° helix  
 DIN 6535 HA shank [h6]  
 Uncoated, TiAlN and Al66Nano



Article-number	D1 [+0.004]	L2	D2	L1	Price	Price	Price
					[in € / piece] uncoated	[in € / piece] TiAlN	[in € / piece] Al66Nano
851 0100	1.00	8	3.00	55	32.10	35.00	35.60
851 0110	1.10	9	3.00	55	32.10	35.00	35.60
851 0120	1.20	9	3.00	55	32.10	35.00	35.60
851 0125	1.25	9	3.00	55	32.10	35.00	35.60
851 0130	1.30	9	3.00	55	32.10	35.00	35.60
851 0135	1.35	9	3.00	55	32.10	35.00	35.60
851 0140	1.40	9	3.00	55	32.10	35.00	35.60
851 0145	1.45	9	3.00	55	32.10	35.00	35.60
851 0150	1.50	9	3.00	68	34.60	37.70	38.20
851 0160	1.60	12	3.00	68	34.60	37.70	38.20
851 0170	1.70	12	3.00	68	34.60	37.70	38.20
851 0180	1.80	12	3.00	68	34.60	37.70	38.20
851 0190	1.90	12	3.00	68	34.60	37.70	38.20
851 0200	2.00	12	3.00	74	34.60	37.70	38.20
851 0210	2.10	15	3.00	74	35.70	38.80	39.30
851 0220	2.20	15	3.00	74	35.70	38.80	39.30
851 0230	2.30	15	3.00	74	35.70	38.80	39.30
851 0240	2.40	15	3.00	74	35.70	38.80	39.30
851 0250	2.50	15	3.00	81	35.70	38.80	39.30
851 0260	2.60	16	3.00	81	35.70	38.80	39.30
851 0270	2.70	16	3.00	81	35.70	38.80	39.30
851 0280	2.80	16	3.00	81	35.70	38.80	39.30
851 0290	2.90	16	3.00	81	35.70	38.80	39.30



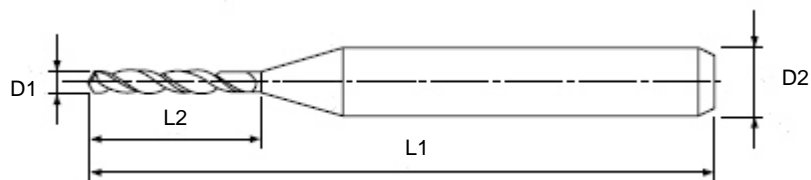
**881 Series [central coolant supply]**  
**Ø 1.00 - 2.90 mm for 8 x D drilling depth**  
**2 cutting edges**  
**140° drill point; self centering**  
**30° helix**  
**DIN 6535 HA shank [h6]**  
**Uncoated, TiAlN and Al66Nano**



Article-number	D1 [+0.004]	L2	D2	L1	Price	Price	Price
					[in € / piece] uncoated	[in € / piece] TiAlN	[in € / piece] Al66Nano
881 0100	1.00	11	3.00	55	37.20	38.80	39.40
881 0110	1.10	17	3.00	55	37.20	38.80	39.40
881 0120	1.20	17	3.00	55	37.20	38.80	39.40
881 0125	1.25	17	3.00	55	37.20	38.80	39.40
881 0130	1.30	17	3.00	55	37.20	38.80	39.40
881 0135	1.35	17	3.00	55	37.20	38.80	39.40
881 0140	1.40	17	3.00	55	37.20	38.80	39.40
881 0145	1.45	17	3.00	55	37.20	38.80	39.40
881 0150	1.50	17	3.00	68	39.40	41.00	41.60
881 0160	1.60	22	3.00	68	39.40	41.00	41.60
881 0170	1.70	22	3.00	68	39.40	41.00	41.60
881 0180	1.80	22	3.00	68	39.40	41.00	41.60
881 0190	1.90	22	3.00	68	39.40	41.00	41.60
881 0200	2.00	22	3.00	74	39.40	41.00	41.60
881 0210	2.10	28	3.00	74	40.40	42.00	42.60
881 0220	2.20	28	3.00	74	40.40	42.00	42.60
881 0230	2.30	28	3.00	74	40.40	42.00	42.60
881 0240	2.40	28	3.00	74	40.40	42.00	42.60
881 0250	2.50	28	3.00	81	42.20	43.80	44.30
881 0260	2.60	32	3.00	81	42.20	43.80	44.30
881 0270	2.70	32	3.00	81	42.20	43.80	44.30
881 0280	2.80	32	3.00	81	42.20	43.80	44.30
881 0290	2.90	32	3.00	81	42.20	43.80	44.30



812 Series [central coolant supply]  
 Ø 1.00 - 2.90 mm for 12 x D drill depth  
 2 cutting edges  
 140° drill point; self centering  
 30° helix  
 DIN 6535 HA shank [h6]  
 Uncoated, TiAlN and Al66Nano



Article-number	D1 [+0.004]	L2	D2	L1	Price	Price	Price
					[in € / piece] uncoated	[in € / piece] TiAlN	[in € / piece] Al66Nano
812 1100	1.00	15	3.00	55	42.20	42.60	44.30
812 1110	1.10	23	3.00	55	42.20	42.60	44.30
812 1120	1.20	23	3.00	55	42.20	42.60	44.30
812 1125	1.25	23	3.00	55	42.20	42.60	44.30
812 1130	1.30	23	3.00	55	42.20	42.60	44.30
812 1135	1.35	23	3.00	55	42.20	42.60	44.30
812 1140	1.40	23	3.00	55	42.20	42.60	44.30
812 1145	1.45	23	3.00	55	42.20	42.60	44.30
812 1150	1.50	23	3.00	68	44.70	46.40	46.80
812 1160	1.60	30	3.00	68	44.70	46.40	46.80
812 1170	1.70	30	3.00	68	44.70	46.40	46.80
812 1180	1.80	30	3.00	68	44.70	46.40	46.80
812 1190	1.90	30	3.00	68	44.70	46.40	46.80
812 1200	2.00	30	3.00	74	44.70	46.40	46.80
812 1210	2.10	38	3.00	74	45.50	47.40	47.90
812 1220	2.20	38	3.00	74	45.50	47.40	47.90
812 1230	2.30	38	3.00	74	45.50	47.40	47.90
812 1240	2.40	38	3.00	74	45.50	47.40	47.90
812 1250	2.50	38	3.00	81	47.30	48.90	49.50
812 1260	2.60	44	3.00	81	47.30	48.90	49.50
812 1270	2.70	44	3.00	81	47.30	48.90	49.50
812 1280	2.80	44	3.00	81	47.30	48.90	49.50
812 1290	2.90	44	3.00	81	47.30	48.90	49.50

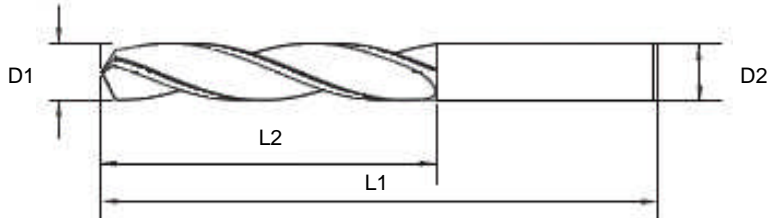
### Maching example

Material: carbon steel 9SMn28 Pb  
 Operation: hole Ø 2.8 mm; drill depth 22.0 mm  
 Machining center: horizontal  
 Adapter: SK40 MAS-BT/JIS to ER20 collet  
 Coolant: 8% emulsion 40 bar presure  
 Tool: **pre-drilling 2xD** 833 250 TiAlN  
**drilling to depth** 812 250 TiAlN

Tool: 833 250 TiAlN **[3xD edition]**  
 Revolutions n: n = 7964 r.p.m  
 Feed rate Vf: Vf = 318 mm/min  
 Tool: 812 250 TiAlN **[12xD edition]**  
 Entering and leaving [2xD] the hole with 5% amount revs.  
 Revolutions n: n = 7964 r.p.m.  
 Feed rate Vf: Vf = 159 mm/min



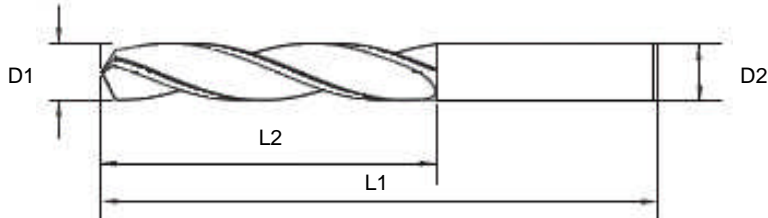
832 Series 3 flute drills  
 Ø 0.60 - 12.50 mm extra short edition  
 3 cutting edges  
 120° drill point  
 30° helix  
 DIN 6539 HA shank [h6]  
 Uncoated, TiAlN and Al66Nano



Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
832 0060K	0.60	3.5	0.60	21	9.30	11.00	11.40
832 0061-0067K	0.61-0.67	4	0.61-0.67	22	9.30	11.00	11.40
832 0068-0075K	0.68-0.75	4.5	0.68-0.75	23	9.30	11.00	11.40
832 0076-0085K	0.76-0.85	5	0.76-0.85	24	9.30	11.00	11.40
832 0086-0095K	0.86-0.95	5.5	0.86-0.95	25	8.30	10.00	10.50
832 0096-0106K	0.96-1.06	6	0.96-1.06	26	8.30	10.00	10.50
832 0107-0118K	1.07-1.18	7	1.07-1.18	28	5.70	7.40	8.00
832 0119-0132K	1.19-1.32	8	1.19-1.32	30	5.70	7.40	8.00
832 0133-0150K	1.33-1.50	9	1.33-1.50	32	5.70	7.40	8.00
832 0151-0170K	1.51-1.70	10	1.51-1.70	34	5.70	7.40	8.00
832 0171-0190K	1.71-1.90	11	1.71-1.90	36	5.70	7.40	8.00
832 0191-0212K	1.91-2.12	12	1.91-2.12	38	6.50	8.30	8.80
832 0213-0236K	2.13-2.36	13	2.13-2.36	40	6.50	8.30	8.80
832 0237-0265K	2.37-2.65	14	2.37-2.65	43	6.50	8.30	8.80
832 0266-0300K	2.66-3.00	16	2.66-3.00	46	6.50	8.30	8.80
832 0301-0335K	3.01-3.35	18	3.01-3.35	49	8.80	10.50	11.10
832 0336-0375K	3.36-3.75	20	3.36-3.75	52	9.30	11.00	11.40
832 0376-0425K	3.76-4.25	22	3.76-4.25	55	12.80	13.80	14.20
832 0426-0475K	4.26-4.75	24	4.26-4.75	58	12.80	13.80	14.20
832 0476-0530K	4.76-5.30	26	4.76-5.30	62	16.40	18.00	18.60
832 0531-0600K	5.31-6.00	28	5.31-6.00	66	17.20	19.00	19.50
832 0601-0670K	6.01-6.70	31	6.01-6.70	70	20.30	23.30	24.80
832 0671-0750K	6.71-7.50	34	6.71-7.50	74	24.40	27.30	28.70
832 0751-0800K	7.51-8.00	37	7.51-8.00	79	49.60	52.50	53.90
832 0810-0850K	8.10-8.50	37	8.10-8.50	79	49.60	52.50	53.90
832 0860-0950K	8.60-9.50	40	8.60-9.50	84	66.90	71.10	73.10
832 0960-1000K	9.60-10.00	43	9.60-10.00	89	91.20	95.30	97.40
832 1010-1050K	10.10-10.50	43	10.10-10.50	89	91.20	96.50	99.40
832 1060-1150K	10.60-11.50	47	10.60-11.50	95	104.60	109.80	112.70
832 1160-1200K	11.60-12.00	51	11.60-12.00	102	104.60	112.60	115.50
832 121001250K	12.10-12.50	51	12.10-12.50	102	104.60	113.30	116.80



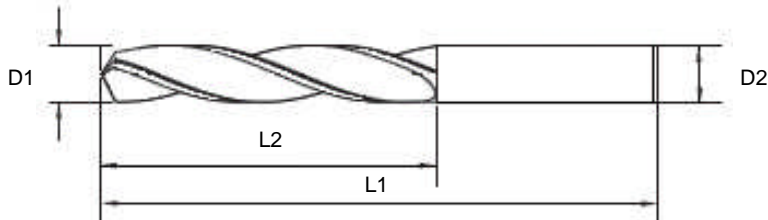
**834 K Series 3 flute drills**  
**Ø 1.00 - 8.50 mm short edition**  
**3 cutting edges**  
**140° drill point; self centering**  
**35° helix**  
**DIN 6535 HA shank [h6]**  
**Uncoated, TiAlN and Al66Nano**



Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
834 0100K	1.00	8	1.00	30	9.30	11.00	11.40
834 0110K	1.10	8	1.10	30	9.30	11.00	11.40
834 0120-0130K	1.20-1.30	10	1.20-1.30	30	14.10	15.90	16.40
834 0140-0150K	1.40-1.50	10	1.40-1.50	30	14.10	15.90	16.40
834 0160-0170K	1.60-1.70	12	1.60-1.70	38	14.10	15.90	16.40
834 0180-0190K	1.86-1.90	12	1.86-1.90	38	14.10	15.90	16.40
834 0200-0210K	2.00-2.10	12	2.00-2.10	38	14.10	15.90	16.40
834 0220-0230K	2.20-2.30	13	2.20-2.30	38	14.10	15.90	16.40
834 0240-0260K	2.40-2.60	14	2.40-2.60	44	14.10	15.90	16.40
834 0270-0300K	2.70-3.00	16	2.70-3.00	44	14.10	15.90	16.40
834 0310-0330K	3.10-3.30	18	3.10-3.30	50	14.10	15.90	16.40
834 0340-0370K	3.40-3.70	20	3.40-3.70	50	16.40	18.20	15.50
834 0380-0420K	3.80-4.20	22	3.80-4.20	54	17.70	19.40	18.60
834 0430-0470K	4.30-4.70	24	4.30-4.70	61	20.60	22.40	22.80
834 0480-0530K	4.80-5.30	26	4.80-5.30	61	22.40	24.00	24.60
834 0540-0600K	5.40-6.00	28	5.40-6.00	66	24.90	26.60	27.20
834 0610-0670K	6.10-6.70	31	6.10-6.70	72	35.90	37.70	40.40
834 0680-0750K	6.80-7.50	34	6.80-7.50	72	38.70	41.60	43.00
834 0760-0800K	7.60-8.00	37	7.60-8.00	83	49.70	53.90	56.00
834 0810-0850K	8.10-8.50	37	8.10-8.50	83	49.70	53.90	56.00



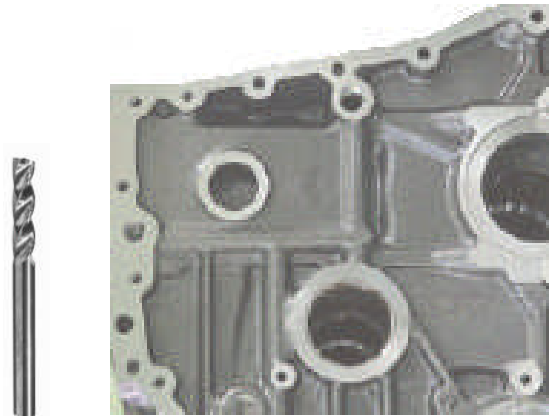
834 L Series 3 flute drills  
 1.00 - 8.50 mm long edition  
 3 cutting edges  
 140° drill point; self centering  
 35° helix  
 DIN 6539 HA shank [h6]  
 Uncoated, TiAlN and Al66Nano



Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
834 0100L	1.00	12	1.00	33	16.40	18.00	18.60
834 0110L	1.10	14	1.10	38	16.40	18.00	18.60
834 0120-0130L	1.20-1.30	16	1.20-1.30	38	17.10	18.80	19.20
834 0140-0150L	1.40-1.50	18	1.40-1.50	38	17.10	18.80	19.20
834 0160-0170L	1.60-1.70	20	1.60-1.70	44	17.10	18.80	19.20
834 0180-0190L	1.86-1.90	22	1.86-1.90	44	17.10	18.80	19.20
834 0200-0210L	2.00-2.10	24	2.00-2.10	50	17.70	19.40	20.00
834 0220-0230L	2.20-2.30	27	2.20-2.30	54	17.70	19.40	20.00
834 0240-0260L	2.40-2.60	30	2.40-2.60	61	20.00	21.40	22.10
834 0270-0300L	2.70-3.00	33	2.70-3.00	61	20.00	21.40	22.10
834 0310-0330L	3.10-3.30	35	3.10-3.30	66	21.80	23.40	23.90
834 0340-0370L	3.40-3.70	39	3.40-3.70	72	24.90	27.00	27.50
834 0380-0420L	3.80-4.20	43	3.80-4.20	72	25.10	31.80	32.40
834 0430-0470L	4.30-4.70	47	4.30-4.70	83	30.20	33.90	34.40
834 0480-0530L	4.80-5.30	52	4.80-5.30	83	40.40	42.20	42.60
834 0540-0600L	5.40-6.00	57	5.40-6.00	92	34.90	43.70	44.20
834 0610-0670L	6.10-6.70	63	6.10-6.70	104	47.10	50.10	60.20
834 0680-0750L	6.80-7.50	69	6.80-7.50	109	48.00	50.90	61.10
834 0760-0800L	7.60-8.00	75	7.60-8.00	117	54.60	58.80	60.80
834 0810-0850L	8.10-8.50	75	8.10-8.50	117	54.60	58.80	60.80

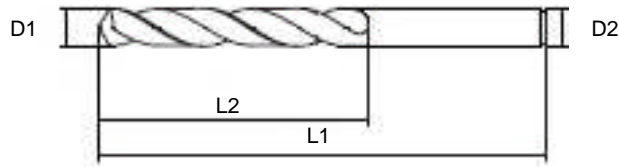
**Maching example**

Workpiece: engine part  
 Material: G-AlSi12  
 Operation: thread hole M8 x 1.25 [2xD depth]  
 Machining center: horizontal  
 Adapter: SK40 MAS-BT/JIS to ER32 collet  
 Coolant: 8% emulsion  
 Tool: 834 0850L  
 Cutting speed Vc / revolutions n: Vc = 70.0 m/min / n = 2622 r.p.m.  
 Feed rate fn and Vf: fn = 0.45 mm and Vf = 1180 mm/min





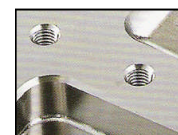
**835 Series jobber drills**  
**Ø 0.70 - 8.50 mm DIN 338**  
**2 cutting edges**  
**120° drill point**  
**24° helix**  
**DIN 6535 HA shank [h6]**  
**Uncoated, TiAlN and Al66ano**



Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
					uncoated	TiAlN	Al66Nano
835 0700-0075	0.70-0.75	9	0.70-0.75	28	7.40	9.60	10.10
835 0076-0085	0.76-0.85	10	0.76-0.85	30	7.40	9.60	10.10
835 0086-0095	0.86-0.95	11	0.86-0.95	32	7.40	9.60	10.10
835 0096-0106	0.96-1.06	12	0.96-1.06	34	7.40	9.60	10.10
835 0107-0119	1.07-1.19	14	1.07-1.19	36	7.40	9.60	10.10
835 0120-0132	1.20-1.32	16	1.20-1.32	38	7.40	9.60	10.10
835 0133-0150	1.33-1.50	18	1.33-1.50	40	7.40	9.60	10.10
835 0151-0174	1.51-1.74	20	1.51-1.74	43	7.40	9.60	10.10
835 0175-0190	1.75-1.90	22	1.75-1.90	46	7.40	9.60	10.10
835 0191-0214	1.91-2.14	24	1.91-2.14	49	9.30	11.00	11.40
835 0215-0239	2.15-2.39	27	2.15-2.39	53	9.30	11.00	11.40
835 0240-0269	2.40-2.69	30	2.40-2.69	57	9.30	11.00	11.40
835 0270-0304	2.70-3.04	33	2.70-3.04	61	9.30	11.00	11.40
835 0305-0339	3.05-3.39	36	3.05-3.39	65	12.40	11.70	14.60
835 0340-0379	3.40-3.79	39	3.40-3.79	70	12.40	11.70	14.60
835 0380-0424	3.80-4.24	43	3.80-4.24	75	12.40	11.70	14.60
835 0425-0479	4.25-4.79	47	4.25-4.79	80	15.60	17.40	17.90
835 0480-0539	4.80-5.39	52	4.80-5.39	86	17.20	20.70	19.50
835 0540-0609	5.40-6.09	57	5.40-6.09	93	19.50	23.70	24.20
835 0610-0679	6.10-6.79	63	6.10-6.79	101	28.10	32.30	32.60
835 0680-0759	6.80-7.59	69	6.80-7.59	109	51.20	54.00	55.50
835 0760-0809	7.60-8.09	75	7.60-8.09	117	60.90	65.10	67.00
835 0810-0850	8.10-8.50	75	8.10-8.50	117	60.90	65.10	67.00

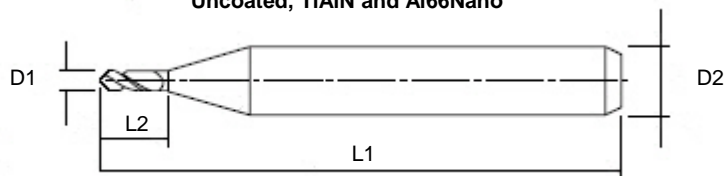
**Machining example**

Workpiece: mold & die part; thread hole M6  
 Material: tool steel DIN 1.2344  
 Machining center: vertical  
 Adapter: SK40 MAS-BT/JIS to ER32 collet  
 Coolant: 8% emulsion  
 Tool: 835 0500  
 Cutting speed Vc / revolutions n: Vc = 60.0 m/min / n = 3821 r.p.m.  
 Feed rate fn and Vf: fn = 0.08 mm and Vf = 305 mm/min





**810 Series center drills**  
 Ø 0.05 - 0.09 mm [tol. - 0.005 / - 0.10 mm]  
 Ø 0.10 - 3.0 mm [tol. -0.01 / - 0.015 mm]  
 Drill point 90°  
 2 cutting edges  
 24° helix  
 DIN 6535 HA shank [h6]  
 Uncoated, TiAlN and Al66Nano

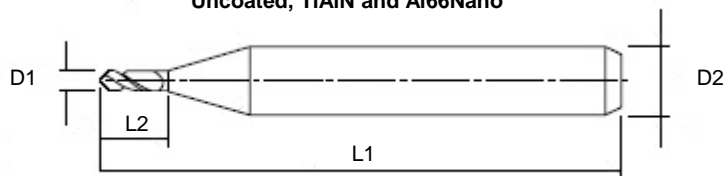


Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
90° drill point					uncoated	TiAlN	Al66Nano
810 005	0.05	0.1	3	38	15.30	17.00	17.40
810 006	0.06	0.1	3	38	15.30	17.00	17.40
810 007	0.07	0.1	3	38	15.30	17.00	17.40
810 008	0.08	0.1	3	38	13.70	18.50	19.10
810 009	0.09	0.1	3	38	12.40	14.10	14.60
810 010	0.10	0.2	3	38	12.40	14.10	14.60
810 015	0.15	0.2	3	38	12.40	14.10	14.60
810 020	0.20	0.4	3	38	12.40	14.10	14.60
810 025	0.25	0.4	3	38	12.40	14.10	14.60
810 030	0.30	0.6	3	38	12.40	14.10	14.60
810 035	0.35	0.6	3	38	12.40	14.10	14.60
810 040	0.40	0.6	3	38	12.40	14.10	14.60
810 045	0.45	0.6	3	38	12.40	14.10	14.60
810 050	0.50	1.0	3	38	12.40	14.10	14.60
810 055	0.55	1.0	3	38	12.40	14.10	14.60
810 060	0.60	1.0	3	38	12.40	14.10	14.60
810 065	0.65	1.0	3	38	12.40	14.10	14.60
810 070	0.70	1.2	3	38	12.40	14.10	14.60
810 075	0.75	1.2	3	38	12.40	14.10	14.60
810 080	0.80	1.2	3	38	12.40	14.10	14.60
810 085	0.85	1.2	3	38	12.40	14.10	14.60
810 090	0.90	1.8	3	38	12.40	14.10	14.60
810 095	0.95	1.8	3	38	12.40	14.10	14.60
810 100	1.00	1.8	3	38	12.40	14.10	14.60
810 150	1.50	2.5	3	38	12.40	14.10	14.60
810 200	2.00	2.5	3	38	12.40	14.10	14.60
810 250	2.50	3.0	3	38	12.40	14.10	14.60
810 300	3.00	3.0	3	38	12.40	14.10	14.60





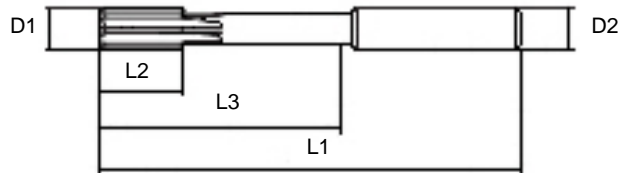
**812 Series center drills**  
 Ø 0.05 - 0.09 mm [tol. - 0.005 / - 0.10 mm]  
 Ø 0.10 - 3.0 mm [tol. -0.01 / - 0.015 mm]  
 Drill point 120°  
 2 cutting edges  
 24° helix  
 DIN 6535 HA shank [h6]  
 Uncoated, TiAlN and Al66Nano



Article-number	D1	L2	D2	L1	Price	Price	Price
					[in € / piece]	[in € / piece]	[in € / piece]
120° drill point					uncoated	TiAlN	Al66Nano
812 005	0.05	0.1	3	38	15.30	17.00	17.40
812 006	0.06	0.1	3	38	15.30	17.00	17.40
812 007	0.07	0.1	3	38	15.30	17.00	17.40
812 008	0.08	0.1	3	38	13.70	18.50	19.10
812 009	0.09	0.1	3	38	12.40	14.10	14.60
812 010	0.10	0.2	3	38	12.40	14.10	14.60
812 015	0.15	0.2	3	38	12.40	14.10	14.60
812 020	0.20	0.4	3	38	12.40	14.10	14.60
812 025	0.25	0.4	3	38	12.40	14.10	14.60
812 030	0.30	0.6	3	38	12.40	14.10	14.60
812 035	0.35	0.6	3	38	12.40	14.10	14.60
812 040	0.40	0.6	3	38	12.40	14.10	14.60
812 045	0.45	0.6	3	38	12.40	14.10	14.60
812 050	0.50	1.0	3	38	12.40	14.10	14.60
812 055	0.55	1.0	3	38	12.40	14.10	14.60
812 060	0.60	1.0	3	38	12.40	14.10	14.60
812 065	0.65	1.0	3	38	12.40	14.10	14.60
812 070	0.70	1.2	3	38	12.40	14.10	14.60
812 075	0.75	1.2	3	38	12.40	14.10	14.60
812 080	0.80	1.2	3	38	12.40	14.10	14.60
812 085	0.85	1.2	3	38	12.40	14.10	14.60
812 090	0.90	1.8	3	38	12.40	14.10	14.60
812 095	0.95	1.8	3	38	12.40	14.10	14.60
812 100	1.00	1.8	3	38	12.40	14.10	14.60
812 150	1.50	2.5	3	38	12.40	14.10	14.60
812 200	2.00	2.5	3	38	12.40	14.10	14.60
812 250	2.50	3.0	3	38	12.40	14.10	14.60
812 300	3.00	3.0	3	38	12.40	14.10	14.60



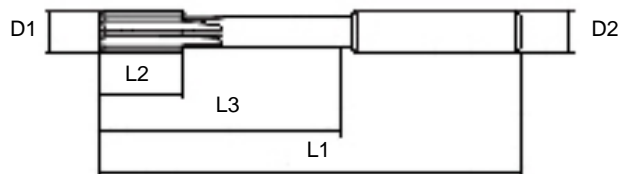
**R2 Series reamers**  
**Ø 0.900 - 12.150 mm**  
**45° T - land**  
**3 - 6 cutting edges**  
**Straight flutes**  
**DIN 6535 HA shank [h6]**  
**Uncoated**



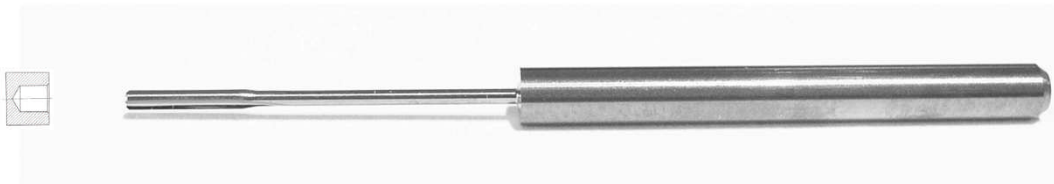
Article-number	D1 +/- 0.002	L2	L3	D2	L1	Number of cutting edges z	Price [in € / piece] uncoated
R2 0900 6-1069 6	0.900-1.069	6	20	3	48	3	29.40
R2 1070 6-1569 6	1.070-1.569	6	20	3	48	3	29.40
R2 1570 6-2069 6	1.570-2.069	6	20	3	48	3	31.10
R2 2070 6-2569 6	2.070-2.569	6	20	3	48	3	31.10
R2 2570 6-3069 6	2.570-3.069	6	20	3	48	4	32.40
R2 3070 8-3569 8	3.070-3.569	8	26	4	54	4	25.80
R2 3570 8-4069 8	3.570-4.069	8	26	4	54	4	30.20
R2 4070 12-4569 12	4.070-4.569	12	38	6	74	6	30.20
R2 4570 12-5069 12	4.570-5.069	12	38	6	74	6	33.00
R2 5070 12-6150 12	5.070-6.150	12	38	6	74	6	35.90
R2 6160 12-6790 12	6.160-6.790	12	55	8	91	6	39.00
R2 6800 16-7150 16	6.800-7.150	16	55	8	91	6	48.00
R2 7160 16-8150 16	7.160-8.150	16	55	8	91	6	50.90
R2 8160 16-8690 16	8.160-8.690	16	63	10	103	6	50.90
R2 8700 20-10150 20	8.700-10.15	20	63	10	103	6	56.90
R2 10160 20-10590 20	10.16-10.59	20	73	12	118	6	65.80
R2 10600 24-12150 24	10.60-12.15	24	73	12	118	6	95.80



R3 Series reamers [central coolant supply]  
 Ø 0.900 - 12.150 mm [tol. +/- 0.002 mm]  
 45° T - land  
 3 - 6 cutting edges  
 Straight chip flutes  
 DIN 6535 HA shank  
 Uncoated



Article-number	D1 +/- 0.002	L2	L3	D2	L1	Number of cutting edges z	Price [in € / piece] uncoated
R3 0900 6-1069 6	0.900-1.069	6	20	3	48	3	On request
R3 1070 6-1569 6	1.070-1.569	6	20	3	48	3	On request
R3 1570 6-2069 6	1.570-2.069	6	20	3	48	3	On request
R3 2070 6-2569 6	2.070-2.569	6	20	3	48	3	On request
R3 2570 6-3069 6	2.570-3.069	6	20	3	48	4	On request
R3 3070 8-3569 8	3.070-3.569	8	26	4	54	4	34.00
R3 3570 8-4069 8	3.570-4.069	8	26	4	54	4	35.60
R3 4070 12-4569 12	4.070-4.569	12	38	6	74	6	38.20
R3 4570 12-5069 12	4.570-5.069	12	38	6	74	6	41.10
R3 5070 12-6150 12	5.070-6.150	12	38	6	74	6	44.60
R3 6160 12-6790 12	6.160-6.790	12	55	8	91	6	47.10
R3 6800 16-7150 16	6.800-7.150	16	55	8	91	6	53.80
R3 7160 16 8150 16	7.160-8.150	16	55	8	91	6	58.20
R3 8160 16-8690 16	8.160-8.690	16	63	10	103	6	58.20
R3 8700 20-10150 20	8.700-10.15	20	63	10	103	6	65.80
R3 10160 20-10590 20	10.16-10.59	20	73	12	118	6	74.70
R3 10600 24-12150 24	10.60-12.15	24	73	12	118	6	108.60

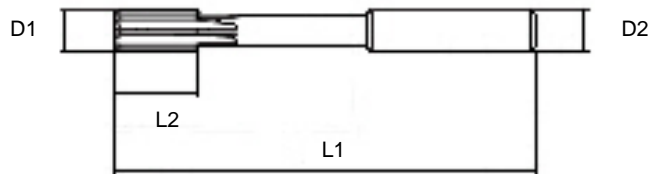


#### Machining example

Workpiece:	fixture
Material:	AlMg1
Operation:	hole [K6 tolerance]
Machining center:	horizontal
Adapter:	SK40 MAS-BT/JIS to ER20 collet
Coolant:	8% emulsion
Tool:	R3 2500 6
Cutting speed Vc / revolutions n:	Vc = 80.0 m/min / n = 10190 r.p.m.
Feed rate fn and Vf:	fn = 0.2 mm and Vf = 2038 mm/min



**R2 2S Series reamers**  
**Ø 3.00 - 8.00 mm [h7]**  
**45° T - land**  
**2 cutting edges**  
**Straight chip flutes**  
**DIN 6535 HA shank [h6]**  
**Uncoated**



Article-number	D1 [e8]	L2	D2	L1	Number of cutting edges z	Price [in € / piece] uncoated
R2 2S 0300 18	3.00	18	6	82	2	24.20
R2 2S 0330 20	3.30	20	6	82	2	24.20
R2 2S 0350 21	3.50	21	6	82	2	24.20
R2 2S 0400 24	4.00	24	6	82	2	24.20
R2 2S 0420 26	4.20	26	6	82	2	30.20
R2 2S 0450 27	4.50	27	6	82	2	30.20
R2 2S 0500 30	5.00	30	6	82	2	30.20
R2 2S 0550 33	5.50	33	6	94	2	30.20
R2 2S 0600 36	6.00	36	6	94	2	30.20
R2 2S 0650 39	6.50	39	8	102	2	41.90
R2 2S 0680 41	6.80	41	8	102	2	41.90
R2 2S 0700 42	7.00	42	8	102	2	41.90
R2 2S 0750 45	7.50	45	8	108	2	53.80
R2 2S 0800 48	8.00	48	8	108	2	53.80
R2 2S 0300 36	3.00	36	6	82	2	35.90
R2 2S 0330 40	3.30	40	6	82	2	35.90
R2 2S 0350 42	3.50	42	6	82	2	35.90
R2 2S 0400 48	4.00	48	6	82	2	35.90
R2 2S 0420 51	4.20	51	6	82	2	48.00
R2 2S 0450 54	4.50	54	6	82	2	48.00
R2 2S 0500 60	5.00	60	6	82	2	48.00
R2 2S 0550 66	5.50	66	6	94	2	48.00
R2 2S 0600 72	6.00	72	6	94	2	48.00
R2 2S 0650 78	6.50	78	8	102	2	65.80
R2 2S 0680 82	6.80	82	8	102	2	65.80
R2 2S 0700 84	7.00	84	8	102	2	65.80
R2 2S 0750 90	7.50	90	8	108	2	77.60
R2 2S 0800 96	8.00	96	8	108	2	77.60



**241 Series 1 cutting edge end mills**

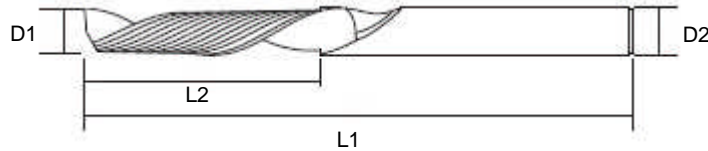
**Ø 0.10 - 12.00 mm**

**1 cutting edge**

**30° helix**

**DIN 6535 HA shank [h6]**

**Uncoated**



Article-number	D1 [h6]	L2	D2	L1	Price [in € / piece]
241 001	0.10	0.3	3.00	38	On request
241 002	0.20	0.6	3.00	38	On request
241 003	0.30	1.0	3.00	38	On request
241 004	0.40	1.0	3.00	38	On request
241 005	0.50	1.5	3.00	38	On request
241 006	0.60	3.0	3.00	38	15.30
241 007	0.70	4.0	3.00	38	15.30
241 008	0.80	5.0	3.00	38	15.30
241 009	0.90	5.0	3.00	38	15.30
241 010	1.00	5.0	3.00	38	13.70
241 011	1.10	5.0	3.00	38	13.70
241 012	1.20	5.0	3.00	38	13.70
241 013	1.30	5.0	3.00	38	13.70
241 014	1.40	5.0	3.00	38	13.70
241 015	1.50	5.0	3.00	38	13.70
241 016	1.60	6.0	3.00	38	13.70
241 017	1.70	7.0	3.00	38	13.70
241 018	1.80	7.0	3.00	38	13.70
241 019	1.90	7.0	3.00	38	13.70
241 020	2.00	10.0	3.00	38	13.70
241 022	2.20	10.0	3.00	38	13.70
241 024	2.40	10.0	3.00	38	13.70
241 025	2.50	10.0	3.00	38	13.70
241 026	2.60	10.0	3.00	38	13.70
241 028	2.80	10.0	3.00	38	13.70
241 030	3.00	10.0	3.00	38	13.70
241 040	4.00	11.0	6.00	54	10.10
241 050	5.00	13.0	6.00	54	10.10
241 060	7.00	13.0	6.00	54	10.10
241 080	8.00	19.0	8.00	58	12.00
241 100	10.00	22.0	10.00	66	19.10
241 120	12.00	26.0	12.00	73	25.10

**Machining example**

Workpiece:

Distance layer

Material:

CFK

Operation:

3 axis simultaneous

Machining center:

vertical

Adapter:

SK30 MAS-BT/JIS - ER25

Coolant:

air [suction]

Tool:

241 080

Cutting speed Vc:

Vc = 70.0 m/min

Revolutions n:

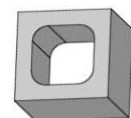
n = 2786 r.p.m.

Feed rate fz:

fz = 0.10 - 0.15 mm

Feed rate Vf:

Vf = 278 - 418 mm/min





**847 Series engraving spikes**

**Ø 2.00 - 8.00 mm**

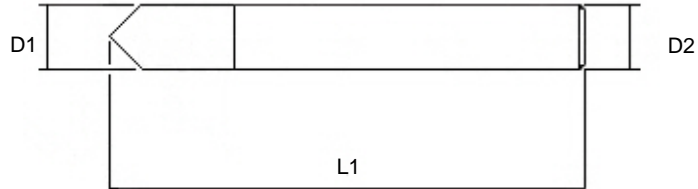
**0.2 mm [tol.+/- 0.05] edge preparation on the cutting edge**

**1 cutting edge with engraving angle 30°, 45°, 60° or 90°**

**Straight chip flute**

**DIN 6535 HA shank [h6]**

**Uncoated**



Article-number	Engraving angle				D1 [h6]	D2 [h6]	L1	Price [in € / piece] uncoated
	XX	in °						
847 020 XX	30	45	60	90	2.00	2.00	38	8.80
847 030 XX	30	45	60	90	3.00	3.00	38	8.80
847 031 XX	30	45	60	90	3.175	3.175	38	8.80
847 040 XX	30	45	60	90	4.00	4.00	50	12.40
847 050 XX	30	45	60	90	5.00	5.00	50	17.10
847 060 XX	30	45	60	90	6.00	6.00	50	20.80
847 080 XX	30	45	60	90	8.00	8.00	50	27.00

**Machining example**

Workpiece:	mold & die part
Material:	tool steel
Hardened:	62 HRc
Operation:	marking
Machining center:	vertical
Adapter:	SK40 MAS-BT/JIS to ER20 collet
Coolant:	air blast
Tool:	847 060 45
Cutting speed Vc / revolutions n:	Vc = 18.8 m/min / n = 20000 r.p.m
Umber of teeth z:	1
Feed rate fn and Vf:	fn = 0.02 mm and Vf = 400 mm/min



## Cutting speeds Vc for drills, reamers and end mills



<b>Carbon steel</b>	<b>Examples [DIN/W.Nr]</b>	<b>Vc</b>
< 450 N/mm <sup>2</sup>	C15 C22 Ck15 St37-3 9SMn28	70 - 90 m/min
< 850 N/mm <sup>2</sup>	St50-2 16CrMo4 12CrMo19 5	50 - 70 m/min
< 1100 N/mm <sup>2</sup>	St60-2 St70-2 42CrV6 51CrMoV4	40 - 50 m/min
<b>Low alloyed steel</b>		
< 600 N/mm <sup>2</sup>	100Cr6 42Cr4 51CrV4	60 - 70 m/min
< 1000 N/mm <sup>2</sup>	31NiCr14 100Cr2 36NiCr6	50 - 60 m/min
< 1300 N/mm <sup>2</sup>	40CrMn7 35NiCr18 42CrMo4	40 - 50 m/min
<b>High alloyed steel</b>		
< 700 N/mm <sup>2</sup>	X40CrMoV5 X155CrVMo12 1	40 - 50 m/min
< 1200 N/mm <sup>2</sup>	S-12-1-4-5 S-6-5-2	30 - 40 m/min
<b>Stainless steel</b>	<b>Examples [DIN/W.Nr]</b>	<b>Vc</b>
<b>Ferritic/martensitic</b>	1.4021 1.4305 1.4448 1.4762	50 - 60 m/min
<b>Martensitic</b>	1.4034 1.4057 1.4125	40 - 50 m/min
<b>Austenitic</b>	1.4301 1.4311 1.4404 1.4462	30 - 40 m/min
<b>Cast iron</b>	<b>Examples [DIN/W.Nr]</b>	<b>Vc</b>
Grey cast iron [<180-HB]	EN-GJL-110 EN-GJL-150	90 - 70 m/min
Grey cast iron [<260HB]	EN-GJL-250 EN-GJL-400	70 - 50 m/min
Nodular cast iron [<160HB]	EN-GJS-350 EN-GJS-400	50 - 40 m/min
Nodular cast iron [<250HB]	EN-GJS-500 EN-GJS-700	40 - 30 m/min
<b>Non ferretic materials</b>	<b>Examples [DIN/W.Nr]</b>	<b>Vc</b>
<b>Aluminium alloys</b>		
< 250 N/mm <sup>2</sup>	Al99.5 AlMg1	80 - 120 m/min
< 300 N/mm <sup>2</sup> / < 12% Si	G-AlSi12 G-AlSi10Mg	50 - 70 m/min
<b>Copper alloys</b>		
Brass	CuZn15 CuZn30 G-CuPb20Sn	40 - 60 m/min
Electrolytic copper	CuAl10Ni5Fe4 G-CuAl10Ni	60 - 80 m/min
<b>Plastics</b>		
Duroplastics	Responal / Novodur	80 - 100 m/min
Thermoplastics	Bakelit / Pertinax	70 - 90 m/min
<b>Heat resistant alloys</b>	<b>Tensile strength Rm in N/mm<sup>2</sup></b>	<b>Vc</b>
Iron based	800 - 1200	20 - 25 m/min
Nickel based	1000 - 1450	25 - 30 m/min
Cobalt based	1000 - 1450	25 - 30 m/min
Titanium alloys	900 - 1600	30 - 35 m/min
<b>Hardened materials</b>	<b>Examples [DIN/W.Nr]</b>	<b>Vc</b>
Tool steel [40-48 HRc]	-	25 - 35 m/min
Tool steel [48-52 HRc]	-	15 - 25 m/min
Hardened cast iron	G-X260NiCr4 2 [< 48 HRc]	25 - 35 m/min

## Formulas and symbols



$$\text{Cutting speed } V_c = \frac{D \times \pi \times n}{1000} \text{ in m/min}$$

**V<sub>c</sub>**: cutting speed in m/min  
**D**: cutting diameter in mm  
**π**: value pí; ≈ 3.14  
**n**: number of revolutions/min

$$\text{Revolutions } n = \frac{V_c \times 1000}{D \times \pi} \text{ in r.p.m.}$$

**n**: number of revolutions/min  
**D**: cutting diameter in mm  
**π**: value pí; ≈ 3.14  
**V<sub>c</sub>**: cutting speed in m/min

$$\text{Table feed rate } V_f = f_z \times z \times n \text{ in mm/min}$$

**V<sub>f</sub>**: table feed rate in mm/min  
**f<sub>z</sub>**: feed rate/tooth in mm  
**z**: number of teeth  
**n**: number of revolutions/min

$$\text{Feed rate/tooth } f_z = \frac{V_f}{z \times n} \text{ in mm}$$

**f<sub>z</sub>**: feed rate/tooth in mm  
**V<sub>f</sub>**: table feed in mm/min  
**z**: number of teeth  
**n**: number of revolutions/min

$$\text{Chip volume } Q = \frac{A_p \times A_e \times V_f}{1000} \text{ in cm}^3/\text{min}$$

**Q**: chip volume in cm<sup>3</sup>/min  
**D.O.C./A<sub>p</sub>**: depth of cut in mm  
**W.O.C./A<sub>e</sub>**: width of cut in mm  
**V<sub>f</sub>**: feed rate in mm/min

$$\text{Surf. roughness } R_{th} = [D : 2] - \frac{\sqrt{[D^2 - A_e^2]}}{4} \text{ in } \mu\text{m}$$

**R<sub>th</sub>**: theoretical surface roughness in μm  
**D**: cutting diameter in mm  
**W.O.C./A<sub>e</sub>**: width of cut in mm

$$\text{Power } P_c = \frac{[A_p \times A_e \times V_f \times k_c]}{60000 \times 10^3 \times \eta} \text{ in cm}^3/\text{min}$$

**P<sub>c</sub>**: power requirement in kW  
**D.O.C./A<sub>p</sub>**: depth of cut in mm  
**W.O.C./A<sub>e</sub>**: width of cut in mm  
**K<sub>c</sub>**: specific cutting forces  
**η**: spindel efficiency [factor 0.85]

$$\text{Torque } M_c = \frac{[D : 2] \times f_z \times z \times k_c}{8000} \text{ in Nm}$$

**M<sub>c</sub>**: torque in Nm  
**f<sub>z</sub>**: feed rate/tooth in mm  
**z**: number of teeth  
**K<sub>c</sub>**: specific cutting force



## Approximate values specific cutting forces



Carbon steel	fz = 0.05	0.1	0.16	0.2	0.25	0.3
< 450 N/mm <sup>2</sup>	2900	2600	2400	2300	2250	2200
< 850 N/mm <sup>2</sup>	4350	3600	3200	3000	2850	2700
< 1100 N/mm <sup>2</sup>	3500	3400	3100	2900	2600	2550
<b>Low alloyed steel</b>						
< 600 N/mm <sup>2</sup>	4500	3400	2800	2600	2500	2400
< 1000 N/mm <sup>2</sup>	3800	3200	2800	2600	2500	2400
< 1300 N/mm <sup>2</sup>	5400	4500	4000	3800	3600	3400
<b>High alloyed steel</b>						
< 700 N/mm <sup>2</sup>	4000	3300	2900	2800	2600	2500
< 1200 N/mm <sup>2</sup>	4000	3300	2900	2800	2600	2500

Stainless steel	fz = 0.05	0.1	0.16	0.2	0.25	0.3
Ferrit./martensit.	4000	3600	3300	2900	2750	2600
Martensitic	4000	3600	3300	2900	2750	2600
Austenitic	4600	4000	3700	3500	3400	3300

Cast iron	fz = 0.05	0.1	0.16	0.2	0.25	0.3
Grey cast iron	2500	2400	1850	1750	1650	1600
Nodular cast iron	2150	1800	1600	1500	1400	1350
Malleable c. iron	3650	3200	2900	2800	2700	2600

Aluminium alloys	fz = 0.05	0.1	0.16	0.2	0.25	0.3
< 250 N/mm <sup>2</sup>	1550	1300	1200	1100	1050	1000
< 12% Si	1650	1400	1300	1200	1150	1100
<b>Copper alloys</b>						
Pb > 1%	1350	1150	1000	950	900	850
Electrolitic copper	1750	1500	1350	1300	1200	1150

Heat resistant all.	fz = 0.05	0.1	0.16	0.2	0.25	0.3
Iron based	4600	4100	4000	3800	3400	3200
Nickel based	5000	4100	4000	3800	3100	2900
Cobalt based	5000	4100	4000	3800	3200	2900
Titanium alloys	2600	2200	2100	2000	1800	1700

Hardened steel	fz = 0.05	0.1	0.16	0.2	0.25	0.3
48 – 52 HRc	5500	4750	4300	4100	4000	3800
52 – 60 HRc	6400	5550	5050	4800	4600	4450
60 – 68 HRc	7300	6350	5800	5500	5300	5100

Small diameters =>

low cutting speeds Vc and high revolutions n



Ø in mm	Cutting speed Vc in m/min						
	5	10	15	20	25	30	40
0.1	16130	32260	48390	64520	80650	96780	129040
0.2	8065	16130	24195	32260	40325	48390	64520
0.3	5377	10753	16130	21507	26883	32260	43012
0.4	4033	8065	12100	16130	20163	24195	32260
0.5	3185	6370	9555	12740	15925	19110	25480
0.6	2688	5376	8064	10752	13440	16128	21504
0.7	2272	4544	6816	9088	11360	13632	18176
0.8	2016	4032	6050	8065	10082	12098	16128
0.9	1766	3532	5298	7064	8830	10596	14128
1.0	1592	3184	4776	6368	7960	9552	12736
1.5	1061	2122	3183	4244	5305	6366	8488
2.0	796	1592	2388	3184	3980	4776	6368
2.5	637	1274	1911	2548	3185	3822	5096
3.0	530	1060	1590	2120	2650	3180	4240
4.0	398	796	1194	1592	1990	2388	3184
5.0	318	636	954	1272	1509	1908	2544
6.0	265	530	795	1060	1325	1590	2120
8.0	199	396	597	792	995	1188	1584
10.0	159	318	477	636	795	954	1272
12.0	132	264	396	528	660	792	1056

$$\text{Revolutions } n = \frac{V_c \times 1000}{D \times \pi} \text{ in r.p.m.}$$

n: number of revolutions/min  
D: cutting diameter in mm  
π: value pí; ≈ 3.14  
Vc: cutting speed in m/min

## Feed rate $f_n$ for drills



$\varnothing$ in mm	Feed rate $f_n$ in mm/rev.					
	P [Steel]	M [Stainless]	K [Cast iron]	N [Non ferretic]	S [Exot. alloys]	H [Hardened]
0.1	0.005	0.025	0.008	0.010	0.025	0.005
0.2	0.008	0.004	0.012	0.012	0.004	0.007
0.3	0.012	0.006	0.016	0.016	0.006	0.009
0.4	0.016	0.008	0.020	0.020	0.008	0.011
0.5	0.020	0.010	0.022	0.022	0.010	0.013
0.6	0.022	0.012	0.024	0.024	0.012	0.015
0.7	0.024	0.014	0.026	0.026	0.014	0.017
0.8	0.026	0.016	0.028	0.028	0.016	0.019
0.9	0.028	0.018	0.03	0.03	0.018	0.021
1.0	0.03	0.020	0.05	0.05	0.020	0.023
1.5	0.04	0.025	0.08	0.08	0.025	0.026
2.0	0.06	0.030	0.09	0.10	0.030	0.03
2.5	0.08	0.040	0.10	0.12	0.040	0.04
3.0	0.09	0.045	0.12	0.14	0.045	0.05
4.0	0.10	0.06	0.14	0.16	0.06	0.08
5.0	0.12	0.08	0.16	0.18	0.08	0.10
6.0	0.14	0.12	0.18	0.22	0.12	0.12
8.0	0.16	0.14	0.22	0.26	0.14	0.14
10.0	0.2	0.16	0.25	0.30	0.16	0.16
12.0	0.25	0.18	0.28	0.35	0.18	0.20

Vf: feed rate in mm/min  
 $f_n$ : feed rate/rev. in mm

## Feed rate $f_n$ for reaming



$\varnothing$ in mm	Feed rate $f_n$ in mm/rev.					
	P [Steel]	M [Stainless]	K [Cast iron]	N [Non ferretic]	S [Exot. alloys]	H [Hardened]
0.9- 1.0	0.10- 0.14	0.08- 0.12	0.12- 0.16	0.12- 0.16	0.06- 0.10	0.08- 0.12
1.1- 1.5	0.12- 0.16	0.10- 0.14	0.14- 0.18	0.14- 0.18	0.08- 0.12	0.10- 0.14
1.6- 2.0	0.14- 0.18	0.12- 0.16	0.16- 0.20	0.16- 0.20	0.10- 0.14	0.12- 0.16
2.1- 2.5	0.16- 0.20	0.14- 0.18	0.18- 0.22	0.18- 0.22	0.12- 0.16	0.14- 0.18
2.6- 3.0	0.18- 0.22	0.16- 0.20	0.20- 0.24	0.20- 0.24	0.14- 0.18	0.16- 0.20
3.1- 4.0	0.20- 0.26	0.18- 0.24	0.22- 0.28	0.22- 0.28	0.16- 0.22	0.18- 0.24
4.1- 6.0	0.24- 0.30	0.22- 0.28	0.26- 0.32	0.26- 0.32	0.20- 0.26	0.22- 0.28
6.1- 8.0	0.26- 0.35	0.24- 0.30	0.30- 0.38	0.30- 0.38	0.22- 0.28	0.24- 0.30
8.1- 12.0	0.30- 0.40	0.28- 0.35	0.32- 0.45	0.32- 0.45	0.24- 0.30	0.28- 0.35

Cutting speed $V_c$ in m/min					
45 - 25	25 - 15	40 - 20	80 - 70	20 - 15	20 - 10

Stock removal [2x $A_p$ ] on the diameter in mm	
0.9- 1.0	0.04 - 0.10
1.1- 1.5	0.06 - 0.12
1.6- 2.0	0.08 - 0.14
2.1- 2.5	0.08 - 0.16
2.6- 3.0	0.10 - 0.18
3.1- 4.0	0.10 - 0.18
4.1- 6.0	0.12 - 0.20
6.1- 8.0	0.14 - 0.20
8.1- 12.0	0.16 - 0.22

$A_p$  [D.O.C.]: depth of cut in mm => in radius

## Feed rates fz for end mills



Ø in mm	Feed rate fz in mm/tooth		
	P [Steel]	M [Stainless]	N [Non ferretic]
0.1 – 0.3	0.006- 0.008	0.005- 0.007	0.008- 0.010
0.4 – 0.6	0.008- 0.010	0.007- 0.008	0.010- 0.012
0.7 – 1.0	0.010- 0.014	0.008- 0.010	0.012- 0.016
1.1 – 1.5	0.014- 0.016	0.010- 0.012	0.016- 0.018
1.6 – 2.0	0.016- 0.018	0.012- 0.016	0.018- 0.020
2.2 – 3.0	0.018- 0.026	0.016- 0.020	0.020- 0.028
4.0	0.026- 0.035	0.020 - 0.030	0.026- 0.038
5.0	0.035- 0.040	0.030 - 0.036	0.038- 0.044
6.0	0.040- 0.060	0.036 - 0.045	0.044- 0.065
8.0	0.060- 0.100	0.045 - 0.070	0.065- 0.120
10.0	0.100- 0.120	0.070 - 0.090	0.120- 0.140
12.0	0.120- 0.140	0.090 - 0.110	0.140-0.160

Table feed rate  $V_f = fz \times z \times n$  in mm/min

$V_f$ : table feed rate in mm/min  
 $fz$ : feed rate/tooth in mm  
 $z$ : number of teeth  
 $n$ : number of revolutions/min

$V_f$   
 Feed rate/tooth  $fz = \frac{V_f}{z \times n}$  in mm

$fz$ : feed rate/tooth in mm  
 $V_f$ : table feed in mm/min  
 $z$ : number of teeth  
 $n$ : number of revolutions/min

## Troubles versus counter measures



Trouble	Situation and cause	Counter measures
Breakage of tool	engaging workpiece	Decrease feed rate $V_f$
	leaving workpiece	Decrease feed rate $V_f$
	during cutting	Decrease feed rate $V_f$
	excessive wear	Earlier tool change
	run out	Replace adapter
	dry machining	Change to wet machining
Fracture of cutting edge	chipping	Decrease feed rate $V_f$
	large fracture	Decrease cutting speed $V_c$ Replace adapter From dry to wet machining Decrease feed rate $V_f$ Increase coolant supply
Quick tool wear	cutting speed $V_c$	Decrease cutting speed $V_c$ Increase feed rate $V_f$ Utilize coolant Check grinded tool Utilize coated edition
Chattering	fixture / workpiece	Increase feed rate $V_f$ Change cutting speed $V_c$



**Waterhuizerweg 50**

**9753 HS Haren [Gn]**

**The Netherlands**

**Mob.: 0031 [ 0 ] 6 48 27 77 13**

**E - mail: [info@amwsystems.nl](mailto:info@amwsystems.nl)**

**Internet: [www.amwsystems.nl](http://www.amwsystems.nl)**

RABO bank: 12.87.25.850 IBAN n°: NL59 RABO 012 872 58 50 BIC: RABONL2U

ING bank N.V.: 57 38 513 IBAN n°: NL14INGB0005738513 BIC: INGBNL2A

Chamber of commerce.: Groningen 08 15 29 56 VAT n°: NL0613.54.053.B01